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MICHIGAN STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
EAST LANSING

THE QUARTERLY BULLETIN

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THE QUARTERLY BULLETIN

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MICHIGAN STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
EAST LANSING

C. M. HARDIN, DIRECTOR
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J. G. DUNCAN, EDITOR

A HAND-OPERATED MECHANICAL AID FOR DUMPING FRUIT[1]

By J. H. LEVIN[2] and H. P. GASTON[3]

FOR MANY YEARS fruit growers and packers have realized that considerable bruising occurs during most fruit grading and packing operations. Considerable mechanical injury ordinarily occurs in the first step during which the fruit is dumped from field crates onto the receiving belt. Lifting and dumping crates of fruit that weigh from 50 to 60 pounds is hard work. The unskilled laborers who ordinarily perform this type of work are often inclined to be negligent. Even conscientious operators tend to tire and become careless. The result is the same in either case—*bruised fruit.*

Packing house managers have, for a long time, felt a need for a machine capable of doing the job automatically or a simple inexpensive mechanical aid that would make it possible for the employee who dumps the fruit to do better work with less exertion.

In an effort to fill this need many operators have themselves made and used dumping aids of one sort or another. As far as the writers have been able to learn, none of these home-made devices has proved entirely satisfactory. Several commercially built automatic or semi-automatic machines have been developed and placed on the market. Most of these units have three disadvantages: 1) They tend to be expensive; 2) they are usually somewhat complicated and require expert adjustment if they are to operate effectively; and 3) they occupy considerable space.

A simple, compact, inexpensive and at the same time effective dumping aid has been developed. It was thoroughly tested under actual packing house conditions, during and after the 1950 harvesting season.

1. A report of a study made under the Research and Marketing Act of 1946. Departments of Horticulture and Agricultural Engineering, Agricultural Experiment Station, Michigan State College, and Bureau of Plant Industry, Soils and Agricultural Engineering, U.S.D.A. Cooperating.
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3. H. P. Gaston: Department of Horticulture, Michigan State College.

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THE MECHANICAL DUMPER

The mechanism consists of a pivoted crate holder supported by a rigid frame in such a way that a filled crate that has been placed on the holder can be easily raised into dumping position and held (Figs. 2 and 3). In elevating the crate of fruit, the operator is assisted by leverage and the action of a strong coil spring, both of which help to make his job easier.

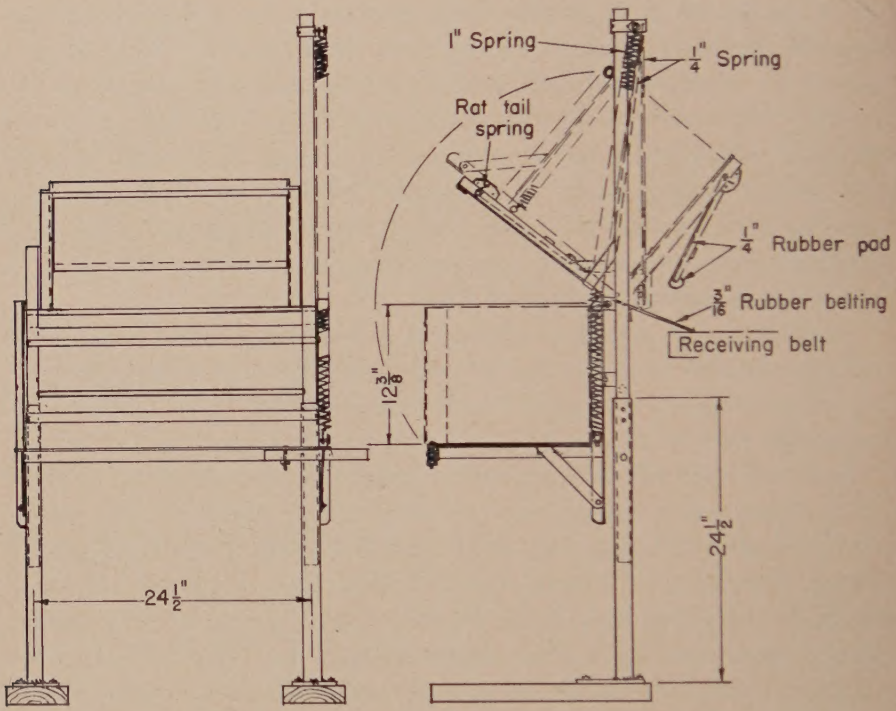

Fig. 1.

As the crate is raised it comes in contact with a padded cover. During the dumping operation this hinged cover is restrained by spring tension (Fig. 4). It regulates the flow of fruit in such a way that bruising is materially reduced.

OPERATION

The dumping operation is most effective when the crates to be emptied are moved to the dumper by means of a roller conveyor, the end of which is close to and about an inch higher than the crate holder

Fig. 2. Side view of mechanical dumper. The operator is in the act of sliding a filled crate onto the crate holder platform.

Fig. 3. The operator has raised the crate holder and crate to dumping position. In doing so he has been assisted by the lift spring visible on the right side of the machine.

Fig. 4. View showing action of padded cover. Note that the fruit is flowing onto the receiving belt in a single layer without significant drop.

Fig. 5. The crate holder has been returned to its original position and the empty crate is being moved away. Note that the crate cover has automatically returned to a position that does not interfere with removal of the "empty" or the placing of another filled crate.

platform (Fig. 2). The conveyor may be placed so that the fruit comes in from either side or from behind the dumper.

When a filled crate reaches the end of the conveyor, the operator slides it onto the crate holder platform. He then grasps the handle and swings the holder and crate into dumping position, and allows the fruit to flow out (Fig. 3). The rate of flow is controlled by the height to which the holder is raised. When the crate is empty, the holder and crate are returned to the first position. The empty crate is then removed (Fig. 5) and the operation repeated.

RESULTS

The dumper has a capacity of several hundred bushels per hour. Each of the commercial lines in which the device was tried packed approximately 100 bushels per hour. For the purpose of determining the capacity of the machine it was operated for short periods of time at the rate of more than 200 bushels per hour. The limited capacity of other units in the grading lines prevented more rapid handling. The workers who performed the dumping operation were of the opinion that the dumper could handle 300 or more bushels per hour without significant mechanical injury to the fruit.

Inasmuch as these devices are relatively inexpensive, and require little space, operators who pack exceptionally large volumes will probably find it to their advantage to install two or more units.

The use of a dumper made it easy to control the flow of fruit. The design of the dumper makes it easy for the operator to pour the fruit onto the receiving belt in a single layer (Fig. 4). This is desirable because of the fact that brushers and eliminators work most effectively when fruit reaches them in this manner.

The machine also makes it easy for the operator to control the flow of the fruit in such a way that there is an almost continuous supply to the sizing, sorting and packing sections. The operators of the commercial lines in which the dumper was tried were of the opinion that this was an important advantage.

Using a mechanical aid made the dumper's job easier. Because of the fact that leverage and a spring are used in lifting and holding the filled crates, the job is easier than it would otherwise be. All of the several operators who used the device said that they did not tire as rapidly as when crates were dumped by hand. In most packing lines the dumper's job is considered one of the most difficult. The packing

crews in both of the houses in which the mechanical aid was installed displayed considerable interest in the machine. After watching it operate for a time, several members of each crew volunteered to take the dumper's assignment. At one of the packing houses where the machine was tested, a woman actually did take over the dumper's work on several occasions when the regular operator was temporarily absent.

Using the device materially reduced bruising. When crates are dumped by hand, the containers are often held in such a way that the fruit is dumped onto the receiving belt from a height of several inches. The result is considerable bruising. A study of this operation in a number of packing lines showed that, on the average, each apple receives during the dumping operation at least one bruise, a quarter of an inch or more in diameter.

When the mechanical dumper is used the apples flow onto the receiving belt without significant drop. Actual counts show that by using the dumper 60 to 70 percent of the bruising that otherwise occurs at this point can be eliminated.

The dumper proved dependable. The dumper was used daily both during and after the 1950 apple harvest season under actual commercial packing house conditions. During this period no adjustments were necessary and no mechanical difficulties developed.

A careful inspection of the device at the end of the trials showed that there had been little wear. The machine is simple, sturdy and has few moving parts; it should last for years and require little special attention.

CONCLUSIONS

Quality fruit commands a premium price. Inasmuch as the dumper materially reduces bruising it should prove a definite asset to any fruit packing line to which it is adapted.

It is difficult to employ workmen who are capable and willing to perform satisfactorily the dumping operation by hand. The use of the machine makes the job so much less difficult that employers who install one of these devices should find it relatively easy to induce workers to accept this assignment.

During the trials here reported the dumper was used for the most part in handling apples. The device could probably be used to advantage in dumping other fruits and vegetables such as peaches, pears and onions. It should, in fact, prove of value in handling any fruit or vegetable that is poured from a field crate onto a packing line.

Manufacturers of grading and packing machinery will no doubt add this piece of equipment to their regular lines. The price should be well within the reach of all commercial operators who use other mechanical devices in sorting, grading and packing.

BACTERIAL DISEASES OF MICHIGAN NAVY PEA BEANS

By AXEL L. ANDERSEN[2]

BACTERIAL DISEASES cause greater losses in Michigan navy pea bean crops than do any other infections of these plants. The losses are the result of several types of infection occurring during the development of the plant. Since several distinct species of bacteria infect beans, it was deemed necessary to determine which one was responsible for the blight in navy pea beans in order that a reliable control program could be initiated.

MATERIALS AND METHODS

Fifty-five samples of bean seeds from the 1949 crop were obtained from nearly as many localities in Michigan. Most of these samples were electric eye pick-outs supplied by various bean elevators in the state. Isolations of bacteria were made from 561 beans and identified and classified according to the cultural reactions outlined by Burkholder[3]. Isolates which could not be identified by the use of Burkholder's key were tested for pathogenicity on Dark Red Kidney and Stringless Green Pod beans in the seedling stage by injecting into the growing point a 24- to 48-hour-old bacterial suspension of the non-identified bacterial isolate.

RESULTS

The results from the isolation and identification program are summarized in Table 1. These results show that *Xanthomonas phaseoli* var. *fuscans* was responsible for the greater portion of the blighted beans delivered to the elevators. The bacteria responsible for common blight and bacterial wilt, which were expected to be the predominating pathogens in this series of isolations, were of minor occurrence.

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[3]Burkholder, W. H. The bacterial diseases of the bean. A comparative study. Cornell University Agricultural Experiment Station, Mem. 127. 1930.

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TABLE 1—*Summary of the bacterial pathogens isolated from navy pea beans of the 1949 crop in Michigan.*

Bacterial isolate and disease	Number of times isolated	Percent of total
Xanthomonas phaseoli (common blight)	53	9.4
Xanthomonas phaseoli var. *fuscans* (fuscous blight)	417	74.5
Corynobacterium flaccumfaciens (bacterial wilt)	17	3.0
Non-identified—weakly pathogenic	74	13.1

The color of the non-identified isolates varied from a pale to a distinct yellow in agar culture. In many respects the isolates resembled the bacterial wilt pathogen. They differed in the production of acid in dextrose, lactose, and sucrose broths. The common and the fuscous blight bacteria do not produce acid in these broths, whereas the wilt organism produces acid in all broths. The non-identified bacteria produced acid in dextrose and sucrose but not in the lactose broths.

The non-identified isolates were weakly pathogenic. Upon injection into plants, they produced brown and purple longitudinal lesions on both sides of the point of injection; and after a 3-week period, bacterial masses oozed out of the stem. Reisolates made from the diseased plants and reinoculated into healthy plants produced similar reactions. The plants seldom became stunted, and only in occasional cases were top symptoms noted. Similar inoculations with the known pathogens caused characteristic reactions.

A few isolations were made from blighted leaves collected in the field during the summer of 1950. Both the common and the fuscous blight organism were isolated. Since these isolations were made from infected leaves collected in a few isolated fields, the results are not conclusive as to the relative prevalence of the two diseases.

SUMMARY

As a result of isolations made in 1949 and 1950, fuscous blight on beans is reported for the first time. The fact that about 75 percent of the bacterial isolates from blighted beans in 1949 were *Xanthomonas phaseoli* var. *fuscans* indicates our need to search for a variety of beans resistant to this pathogen. Search for resistance to this pathogen should be incorporated into the disease-resistance breeding program in Michigan.

LEAF HOPPER CONTROL TO PREVENT THE SPREAD OF THE VIRUS DISEASE ASTER YELLOWS IN COMMERCIAL LETTUCE PRODUCTION

By JULIUS R. HOFFMAN
DEPARTMENT OF ENTOMOLOGY

FOR MANY YEARS one of the factors which has influenced the growing of lettuce in Michigan has been a virus disease known as aster yellows which materially reduces the quality and value of a crop.

Aster yellows, or just "yellows" as this disease will hereafter be called in this article, is spread mainly by leaf hoppers, particularly by the six-spotted leaf hopper (*Macrosteles divisa* [Uhler]). Because the disease is spread by these leaf hoppers, it appears that for satisfactory reduction of the disease in plants, control of these leaf hoppers is necessary.

Parathion was used in an attempt to control the leaf hoppers and, thus, prevent or reduce the spread of yellows. This material was selected because of its high degree of toxicity to insects, its comparatively short residual life, and because chemical methods are available for the analysis of residues remaining on the plant. While DDT is generally considered a more effective insecticide against leaf hoppers, the short growing period of lettuce may permit undesirable residues of DDT to remain on the plants.

The cooperative experiments were carried out at the Trapp and Sons farm at Beulah, Michigan. Two varieties of lettuce were used in the tests, Great Lakes and 456. The parathion spray was prepared by adding ½ pound of the 15 percent parathion wettable powder to 100 gallons of water, and the spray was applied to the lettuce in the conventional manner as is done in commercial practices. The layout of the test utilized four rows of each variety which received one spray treatment on June 22; four rows of each variety which received two spray treatments on June 22 and 30; and four rows of each variety which served as untreated check plants. The test and check rows were approximately in the center of the field of lettuce and ran the length of the field (20 rods). The difference in the number of plants which

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were counted in these tests resulted from the ripening of the lettuce which had to be cut before counts could be made. All counts were made on July 20. Further information is given in the accompanying table.

TABLE 1—*Aster yellows symptoms in parathion-sprayed lettuce plants*

	Treatments	Number of plants showing yellows symptoms	Percent of plants showing yellows symptoms
Variety 456: Drilled May 3, 232 plants per test	2 Sprays	26	11.2
	1 Spray	32	13.8
	Untreated	44	18.9
Variety: Great Lakes: Drilled May 10, 500 plants per test	2 Sprays	34	6.8
	1 Spray	43	8.6
	Untreated	61	12.2

A comparison of the treated plots with the untreated plots indicated that a reduction in the incidence of yellows occurred in the lettuce plants which received sprays of parathion to control leaf hoppers.

Heads of lettuce were selected at random from the field for analysis for residual parathion on July 25, 1950. Individual 500-gram samples of lettuce of each variety and spray treatment series were taken and the residual parathion extracted with 200 milliliters of benzene by shaking for 1 hour. Ten-milliliter alliquots were then taken of each extraction and analyzed photometrically by the method of Averell and Norris[1]. The results of the analysis are shown in Table 2.

TABLE 2—*Parathion residues on lettuce sample 26-34 days after treatment*

Variety	Number of treatments with parathion	Parts per million of parathion
456	2	0.04
Great Lakes	2	0.06
456	1	0.14*
Great Lakes	1	0.08

*The greater amount of residue on this sample as compared with the others may well be due to experimental error. Regardless, this amount still falls well within the "safe range".

[1]Analytical Chemistry, 20:753, 1948.

SUMMARY AND CONCLUSIONS

The application of parathion sprays to field-grown lettuce for the control of leaf hoppers reduced the number of the lettuce plants showing aster yellows symptoms. At the same time, the interval between the last spraying and the harvesting for market was sufficiently long so as to leave no harmful parathion residue on the lettuce.

Further tests are to be conducted in an attempt to reduce the incidence of aster yellows in commercially field grown lettuce plants.

TECHNICAL AND OPERATIONAL PROBLEMS OF SELF-SERVICE MEAT MERCHANDISING

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SELF-SERVICE RETAILING OF FRESH MEAT has increased rapidly since 1946 and has aroused considerable interest in the food retailing industry and in marketing circles. All evidence points to the fact that prepackaged self-service meat merchandising is feasible. Its growth has been phenomenal. In 1944 there were 10 stores offering 100-percent self-service meats; by April, 1949, there were 878 stores in operation, and conversions to this type of meat merchandising are occurring at the rate of 75 or more per month.

During the past few years numerous surveys have been made. Self-service retailing of meat has been reported as applicable to the economic aspects of self-service meats, but little work has been done on the technical problems.

With this in mind, the authors divided their problem into two separate, yet closely related, sections. Part one was concerned with various wrapping materials and their relative serviceability, the primary interest being the differences in shrinkage or drip loss and in the color preservation of the meat. Part two was a more or less practical approach to some of the retailing problems connected with prepackaged self-service meats.

METHODS OF PROCEDURE

The first part of the study was conducted in the Michigan State College Meat Laboratories. The object was to test and compare various wrapping materials used for their serviceability, color preservation, and drip or weight loss of the wrapped meat under controlled conditions. The following materials were used: 300 MSAT No. 80 Cellophane; and aluminum foils of the following thicknesses: 0.0015 inch, heavy; 0.0010 inch, medium; and 0.0007 inch, light.

[1]Present address: The Kroger Company, Cincinnati, Ohio.

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Beef rounds and loins from good and choice grade carcasses that had been aged from 7 to 10 days at 34°-36° F. were boned and cut in a room with a temperature of 50 -58° F. Internal meat temperature ranged from 40° to 46° F. when the meat was packaged according to the following procedure:

1. Nine-by-fifteen-inch sheets of the wrapping materials were individually weighed, as were the backing boards.
2. Individual steaks were cut, weighed, wrapped, placed on shallow meat trays in single layers and immediately stored at 36° F. with a relative humidity of 85-90 percent.
3. Standard storage periods were 24, 48, and 72 hours.
4. After being unwrapped, the meat was permitted to drain or drip for 5 seconds. This fluid was allowed to fall on the respective wrapping material. The meat was then weighed, then the backing board, and lastly, the wrapping material.

Four tests were conducted in a cooperating market, using a total of 96 packages. The procedure followed was the same as that used in the normal store operation, except that all cuts and materials were weighed and the packages placed at various points in the display case and removed in a random fashion.

The first objective of the second part of the study was to check the temperatures of the display cases and determine the normal operating range. For convenience in record keeping, temperatures were taken in the corners and center of each of five open self-service display cases. Internal meat temperatures were taken during various steps of the cooperating market's normal packaging procedure, as follows: removal of wholesale cuts from cooler; cutting; traying and returning to cooler for color development; wrapping; and placing of packages in display case or holding cabinet.

The final objective was to determine the number of packages that were rewrapped or remerchandised. It was thought that some normal operational standard would be obtained that could be used by other operators to measure their relative efficiency in this phase of meat merchandising. During a 2-week period, a physical count was made of all packages wrapped as well as of those that were rewrapped and those that were remerchandised. In view of the facilities afforded, it was impossible to account for the disposition of each package, but the data are believed to be representative and could be used as a comparison for future studies of this type.

In differentiating between rewrapped and remerchandised packages, the following definitions were used: A rewrapped package was one that remained unsold because of a wrapping deficiency, excessive drip, or for reasons other than deterioration of quality of the product. A remerchandised package was one that was unsold due to deterioration in quality of the original product. In this case, the meat may be discarded or reworked and sold as a different product.

RESULTS

Considerable attention was given to weight loss in this study as it was felt that this one feature of prepackaged fresh meats will be closely examined and checked by local or state regulatory groups. A total of 16 tests, involving 400 packages, were made in the laboratory in addition to four tests using 96 packages made in the cooperating market. When the weight losses were averaged for the three storage periods, the following results were obtained:

Material	Percent weight loss	
	Laboratory	Market
Cellophane	2.09	3.81
Al. Foil 0.0015″	1.14	2.57
Al. Foil 0.0010″	1.42	2.46
Al. Foil 0.0007″	1.18	2.40

Color retention was found to be acceptable in most of the packages when a very tight wrap was used. The serviceability of all materials was satisfactory except the 0.0007 inch foil which lacked sufficient tensile strength to produce a tightly wrapped package. Table 1 gives the results of one laboratory test designed for a statistical analysis which showed that differences between materials were highly significant ($P<0.01$), and between periods, significant ($P<0.05$). Figure 1 compares the weight losses between laboratory conditions and those encountered under commercial conditions. Storage periods were averaged for both materials as were the data for the three foil thicknesses. Handling of packages by the market customers undoubtedly increased weight loss. The test packages were handled and replaced by the market customers when the package legend indicated that the product was not for sale.

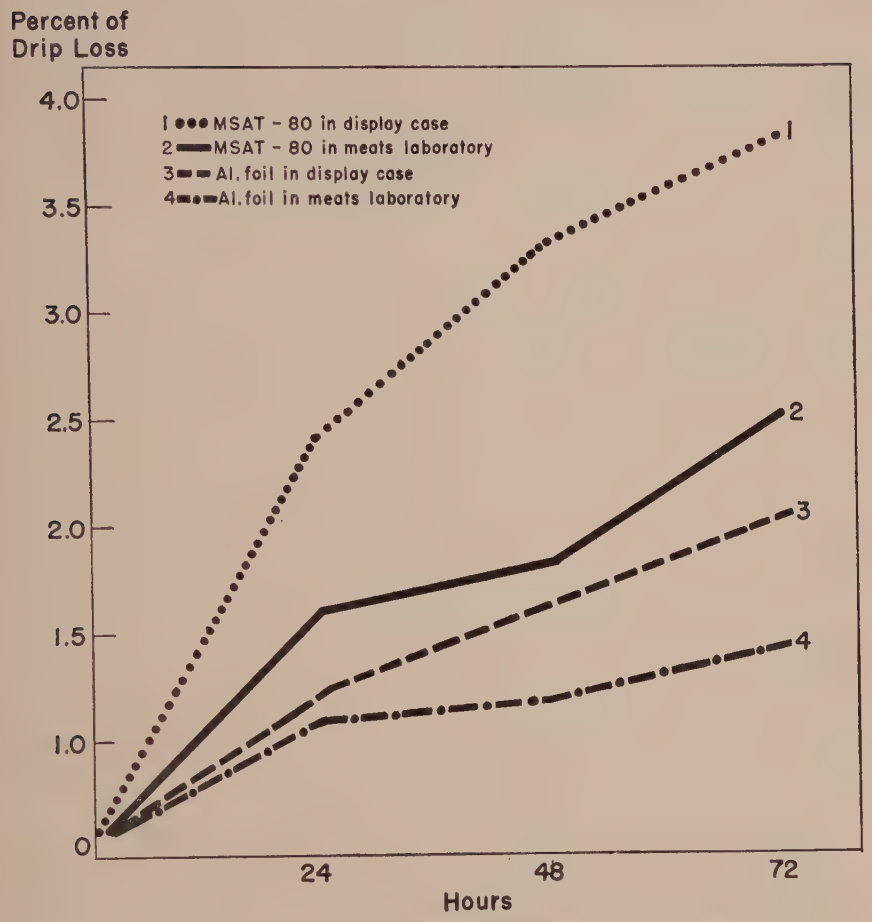

Fig. 1. Comparison of drip loss between materials and storage conditions.

It was found that the maximum temperature range in any one display case was 8° F., or from 32° to 40° F. Some ice crystal formation of free fluid was found within the packages of the lowest layer in the display area. The average temperature of all cases was 36.3° F.

Table 2 presents the internal meat temperatures of packaged round steak displayed for various lengths of time. Package temperatures varied according to the position in the display cases, as the upper layers of displayed products were not as cold as those packages nearer the bottom of the display.

According to Hockman (1) and Wiseman (2), (3), one of the most important factors in maintaining maximum salability of packaged meat is the temperature at which the packaging operations are per-

formed. Table 3 lists a representative group of meat cuts and internal meat temperatures during the various phases of packaging. It was noted that in some instances the meat was exposed to the packaging room temperature of 70°-75° F. for as long as 2 hours. Unfortunately, the type of product normally subjected to this treatment was that requiring the most careful handling, e.g., chop suey meat and ground beef.

TABLE 1—*Percent drip loss of round steak wrapped in different materials stored at 34°-36° F. for three periods*

Storage periods	Material			
	300 MSAT No. 80 Cellophane	0.0015" Al. foil	0.0010" Al. foil	0.0007" Al. foil
24 Hours	1.32	1.07	1.09	0.72
	0.92	1.29	0.74	1.28
	1.76	1.30	0.91	1.22
Average	1.33	1.22	0.91	1.07
48 Hours	1.14	1.40	1.34	0.73
	2.22	1.94	1.49	1.20
	1.55	1.14	0.87	0.99
Average	1.64	1.49	1.23	0.97
72 Hours	2.07	1.30	1.72	1.43
	1.49	1.29	1.29	1.38
	2.10	1.37	1.31	1.30
Average	1.89	1.32	1.44	1.37
Material average	1.62	1.34	1.20	1.14

TABLE 2—*Internal meat temperatures of packaged round steak (cooperating market)*

Temperature of package when put in case (degrees F.)	Hours in display case	Temperature of package when removed from case (degrees F.)
48	24	38
48	24	42
48	48	38
52	48	38
54	72	40
48	72	42

TABLE 3—*Temperature of meat during various phases of the packaging operation (degrees F.) (cooperating market)*

Type of meat	Removal from cooler	Cutting	Returning to holding cooler	Wrapping	Placing in display case
Pork chops	36	38	46	42	48
Pork chops	38	41	48	40	43
Pork chops	35	42	48	46	54
Pork shoulder	36	41	44	54	..
Beef round steak	35	39	39	38	46
Beef sirloin steak	36	39	41	46	..
Beef chuck roast	38	41	44	40-46	48-56
Ground beef	34	..	..	46	54
Ground beef	..	..	44	52	58
Chop suey meat	..	40	..	55-58	63-65
Stew meat	..	36	..	48	56

TABLE 4—*Number of packages wrapped, rewrapped and remerchandised during a two weeks' period (cooperating market)*

Day	Packages wrapped	Packages rewrapped	Percent rewrapped	Packages remerchandised	Percent remerchandised
Monday	1,025	164	16.0	51	5.0
Tuesday	741	28	3.8	14	1.9
Wednesday	631	16	2.5	4	0.6
Thursday	1,462	56	3.8	5	0.3
Friday	1,312	47	3.6	..	...
Saturday	1,487	64	4.3	6	0.4
Weekly total	6,658	375	5.6	80	1.2
Monday	1,121	124	11.1	35	3.1
Tuesday	824	32	3.9	8	1.0
Wednesday	712	22	3.1	9	1.3
Thursday	1,284	44	3.4	5	0.4
Friday	1,400	62	4.4	8	0.6
Saturday	1,346	59	4.4	11	0.8
Weekly total	6,687	343	5.1	76	1.1
Two Weeks' total	13,345	718	5.4	156	1.2

Table 4 presents the data relative to the number and percentage of rewrapped and remerchandised packages for a two week period. It was found that Monday had the largest number of packages that were rewrapped or remerchandised. As the display cases were emptied of all products at the close of the previous week's business, each package was carefully examined before being placed in the case at the beginning of the week. Relatively little rewrapping was done during the mid-week period as handling by customers was at a mini-

mum. During the week-end business, the number of packages rewrapped increased and the number of packages remerchandised decreased. This can be explained by the increased handling and rapid turnover of the packages on Friday and Saturday.

SUMMARY

1. Shrinkage, or drip loss, of fresh meat wrapped in cellophane and three thicknesses of aluminum foil has been compared. Aluminum foil is a very efficient wrapping material when only shrinkage or drip loss is considered.

2. Product temperatures varied greatly during the packaging operation. Long exposure to high packaging room temperatures was serious with ground beef, chop suey meat and meat for stewing.

3. Under commercial operations it was found necessary to rewrap 5.4 percent of the packages, including broken and torn packages as well as those that were unattractive.

4. Packages removed from the display cases and remerchandised or discarded averaged 1.2 percent.

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INJURY TO SQUASH, FIELD PUMPKIN AND CUCUMBER PLANTS RESULTING FROM APPLICATION OF INSECTICIDES

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DURING THE 1950 SEASON many observations were made of the injury by some of the new insecticides to squash, pumpkin and cucumber. Results were gathered from three sources; a departmental experiment at the College for control of the squash insects; a series of plots made available by the Department of Botany and Plant Pathology; and from cooperative tests on the farm of a commercial grower near Munith, Jackson county.

The rapidity with which the new highly effective chemical insect control materials have appeared commercially and experimentally has exceeded the rate of their testing on many crops. On occasion, the application of insecticides to susceptible squash and pumpkin has caused complete crop loss. Carruth and Henry[2] noted this as early as 1947 with DDT. The number of new insecticides is now much greater than in 1947. In order to avoid such unfortunate occurrences, the following report describes injury incurred from insecticidal application. This information will facilitate the inclusion of the safer highly effective materials into the squash, pumpkin, cucumber and related plants insect control program. Dangerous materials may thus be screened out from possible use.

EXPERIMENTAL PROCEDURE AND RESULTS

SQUASH DUSTING

Blue Hubbard variety squash (*Cucurbita maxima*), Butternut variety squash (*C. moschata*), Table Queen variety squash (*C. pepo*), and Small Sugar variety pumpkin were available for observation. These varieties were purposely selected to represent the three species of squashes and field pumpkins.

[1]Photographs by Dr. Julius R. Hoffman, Department of Entomology.
[2]Carruth, L. A., and Hervey, G. E. R. DDT and Other Insecticides for Squash Borer Control. Journ. Econ. Ento. 40(5):716-721. 1947.

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Plants were first dusted on June 21, which was within 10 days of emergence. Subsequent applications were made June 28, July 7, 13, 19 and 26. Alternating with the first three insecticidal applications, three applications of 10 percent Zerlate were made for control of diseases. All materials were applied as dusts by means of hand equipment. A puff-type duster was used for the June applications and during July a rotary-type hand duster was employed. Both of these pieces of equipment were furnished by the Lowell Manufacturing Co.

TABLE 1—*Materials tested*

Insecticide	Number of hills per variety			
	Blue Hubbard	Table Queen	Butternut	Small Sugar
1% Parathion	14	2	2	..
5% Chlordane	14	2	2	..
3% DDT	2	2	2	..
3% Aerosol DDT	14	2	2	..
*5% Compound 1189	2	2	2	..
2½% Aldrin	14	2	2	..
5% Dilan	14	2	2	..
1½% Dieldrin	..	..	..	5
1% Lindane	14	2	2	..
5% Methoxychlor	10	2	2	.
†CPR	12	..	..	.
10% Zerlate (fungicide only)	6	2	2	.

*A numbered experimental material from the General Chemical Company.
†CPR is a trade name for a mixture of rotenone, pyrethrum and an activator or synergist in an inert carrier.

Beginning one day after the first application and continuing over a period of 9 weeks, plant injury observations were recorded. Consolidated readings are shown in Table 2 which follows.

TABLE 2—*Injury of insecticides to varieties of squash and field pumpkin after repeated applications*

Insecticide	Observation (see key)			
	Blue Hubbard	Butternut	Table Queen	Small Sugar
1% Parathion	M-S Nec. and Chlor.	M-S Nec. and Chlor.	M-S Nec. and Chlor.	.
5% Chlordane	M-S Nec. and Chlor.	M-S Nec. and Chlor.	M-S Nec. and Chlor.	.
3% DDT	N	Killed Plant	Killed Plant	.
3% Aerosol DDT	N	L. Nec. and Dist.	L. Chlor.	.
5% Cpd. 1189	L. Nec.	L. Dist.	L. Dist.	.
2½% Aldrin	L. Chlor. and Nec.	L. Dist.	N	.
5% Dilan	N	L. Dist.	L. Dist.	.
1½% Dieldrin	.	.	.	L. Nec.
1% Lindane	N	N	N	.
5% Methoxychlor	N	N	N	.
CPR	N	N	N	.
10% Zerlate	N	N	N	.

Key: N—No injury
L—Light
M—Moderate
S—Severe

Chlor.—Chlorosis or yellowing of leaves.
Nec. —Necrosis or killing of portions of leaves.
Dist. —Distortion or twisting of leaves.

One-percent parathion was very injurious to the foliage of the three species of squash and field pumpkins. Table Queen variety was apparently least affected by parathion, with Butternut occupying a position intermediate to the severe injury caused on Blue Hubbard variety.

Five-percent chlordane dust produced moderate to severe injury on all plants. The typical chlorosis may be seen in Fig. 2. Stunting of the plant followed, although all hills produced squash. Growers

Fig. 1. Typical parathion injury to Blue Hubbard variety squash. Note the complete bleaching of leaf color.

and research workers have expressed the opinion that a serious aspect of the plant injury by parathion and chlordane to squash is that the retardation of growth does delay fruiting and maturation. In this area, yield was reduced although squash were produced.

As was expected and previously reported, 3 percent DDT caused severe necrosis of foliage of Butternut and Table Queen varieties which finally resulted in killing of the plants. However, no detectable injury to Blue Hubbard variety appeared and squash were matured from these plants. Figure 3 shows this specific susceptibility to DDT very plainly. The 3 percent aerosol grade or highly purified DDT did

Fig. 2. Five-percent chlordane dust injury to Blue Hubbard variety squash. Note the crinkling distortion of the leaves.

not damage Blue Hubbard variety but on Table Queen it produced a light distortion of the leaves and light to moderate yellowing and marginal burning of the leaves. On Butternut, 3-percent aerosol grade DDT caused light distortion and some wilting and yellowing or chlorosis of the leaves after three applications.

Five-percent compound 1189 and 2½-percent aldrin appeared to be slightly injurious to foliage although aldrin apparently did not affect the Table Queen variety squash. 5-percent dilan was practically non-toxic to squash plants except for slight twisting or distortion of leaves on Butternut and Table Queen varieties.

One and one-half-percent Dieldrin was tested only on Small Sugar variety of pumpkin and a slight amount of marginal dead tissue or burning of the leaves was noticed.

One-percent Lindane and 5-percent methoxychlor were not apparently injurious to squash and field pumpkin foliage.

CPR did not cause damage nor did the fungicidal treatment of 10-percent Zerlate.

CUCUMBER DUSTING

Two applications of the insecticidal dusts listed below in Table 3 were made to National Pickling variety of cucumber (*Cucumis sativus*). These applications were made by a rotary hand duster on July 20 and 27. At this time the plants were not quite mature and no cucumbers were yet produced.

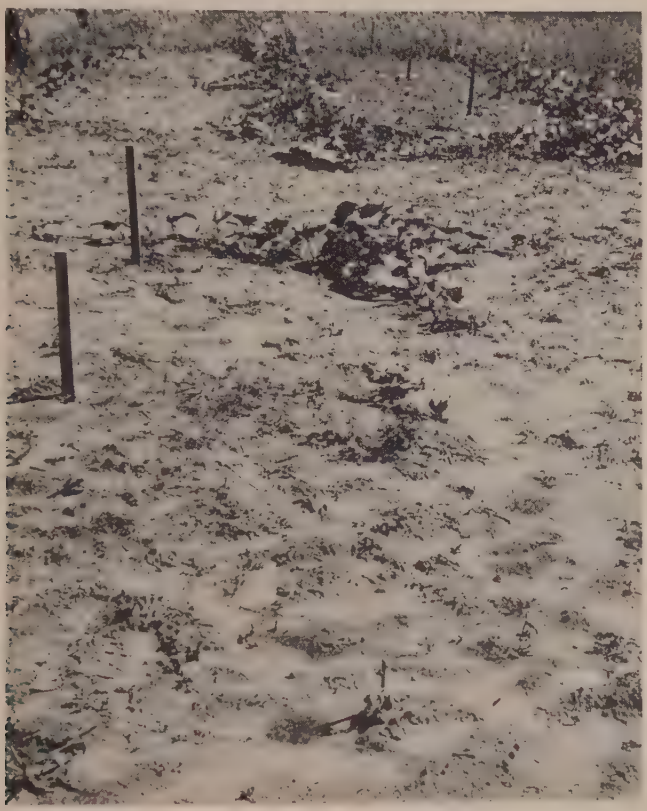

Fig. 3. Specific susceptibility of the three species of squash and field pumpkins to 3-percent DDT dust. In the foreground marked by a small stake is a nearly dead hill of Butternut variety squash. In the middle ground to the right of a large stake is a nearly dead hill of Table Queen variety squash. In the background is a healthy hill of the Blue Hubbard variety. All hills received identical treatment.

Parathion was also injurious to cucumber foliage. Three-percent DDT and 2½-percent aldrin damaged the foliage by slight necrosis in the form of marginal burning. Three-percent aerosol DDT, 5-per-

cent dilan, 5-percent methoxychlor and 1-percent lindane were apparently not harmful to the plants.

TABLE 3—*Insecticidal injury to national pickling variety cucumber plants after the dustings*

Insecticide	Observation
1% Parathion	Light-medium necrosis of foliage
3% DDT	Light necrosis of foliage
2½% Aldrin	Light necrosis of foliage
3% Aerosol DDT	No injury
5% Dilan	No injury
1% Lindane	No injury
1% Methoxychlor	No injury

SQUASH SPRAYING WITH PARATHION

The effectiveness of parathion in killing most insects has led to attempts to apply the chemical to many plants. In order to "safen" parathion for foliage applications, equal amounts of a parathion formulation and charcoal were mixed. The final product consisted of 50-percent parathion and 50-percent Nuchar C (2273-R) charcoal. This charcoal-parathion formulation was sprayed on Blue Hubbard squash at a strength comparable to 1 pound of 15-percent wettable powder parathion per 100 gallons of spray mix. This parathion-charcoal mixture was compared directly with a standard 15-percent wettable powder parathion mix.

The sprayings were carried out on several hills each of previously untreated Blue Hubbard squash. The results showed that both formulations of parathion injured Blue Hubbard foliage. The injury induced by the charcoal-parathion mixture was only slightly less than that caused by the straight parathion.

DISCUSSION AND SUMMARY

Parathion, an organic phosphate insecticide, proved to be injurious to the foliage of squash, field pumpkin and cucumber varieties on which it was tested. Parathion was used as a 1-percent dust and in a spray mix containing a pound of 15-percent parathion wettable powder per 100 gallons of mix. The addition of charcoal "safener" to the spray mix did not prevent injury.

Except for the CPR and Zerlate all other chemicals are chlorinated hydrocarbons. Of the chlorinated hydrocarbons 5-percent chlordane

dust was very toxic to foliage of squash and field pumpkins. Three-percent DDT, used as a previously known injurious material was toxic to the foliage of Table Queen and Butternut varieties of squash but apparently was non-toxic to Hubbard variety squash under conditions of these tests. Three-percent aerosol DDT, 5-percent compound 1189, 2½-percent aldrin, 5-percent dilan and 1½-percent dieldrin seemed to be at times slightly toxic to the foliage of squash and field pumpkins. Cucumbers which are related to the squashes and field pumpkins showed similar susceptibilities to these chlorinated hydrocarbon compounds.

Of the chlorinated hydrocarbon insecticides, only 5-percent methoxychlor and 1-percent lindane caused no injury to plants. Of these, methoxychlor is probably preferable since lindane is known to impart off flavor to vegetable crops under certain conditions.

CPR which is a mixture of rotenone, pyrethrum and an activator or synergist caused no injury to the plants nor was any damage noted through the repeated use of 10-percent Zerlate dust on the squash varieties.

PEACH BLOSSOM BLIGHT CONTROL EXPERIMENTS[1]

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The fungus that causes the brown rot disease of peaches, *Monilinia fructicola*, also infects and kills peach blossoms. This disease, called blossom blight, is characterized by the rapid and complete envelopment of the entire flower. The petals, styles, and filaments of the diseased blossoms become matted together in a dry brittle mass, generally bending downward. Blossom blight does not usually affect the final yield of fruit, for only 10 percent of the blossoms need to set fruit to make a full crop. The damage resulting from blossom blight is indirect, for the dead infected blossoms are a source of billions of secondary spores produced during wet periods throughout the season, becoming very important at peach ripening time when the fruit is most susceptible to infection. Generally, the amount of fruit rot is directly proportional to the number of spores present. Sprays will not give satisfactory fruit rot control when there is a combination of a high spore load and suitable weather for rot development. It is of utmost importance, therefore, to keep blossom infection at a minimum.

BLOSSOM SPRAYS

Recommendations of Michigan State College for blossom sprays are based on the studies of Weaver (1943) and the results of certain programs investigated by Cation (1946) and Dunegan and Goldsworthy (1948). Three or four sprays are suggested during the opening of blossoms, to be applied every 2½ to 3 days until all of the blossoms are open. These provide a protective covering for the newly exposed parts as the blossoms unfold. Only the exposed parts (pistils and stamens) of the open blossoms are very susceptible to infection, and the opening of all the blossoms generally takes place within a 10-day period or sooner. In a year of rapid blossom development,

[1]The data presented in this paper were obtained during the course of studies supported in part by a grant from the Standard Oil Company (Indiana).
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fewer sprays are required. If the weather during the blossom-opening period is very dry, little or no blight occurs. In the 1949 season, very warm weather induced a short bloom period of 4 days, and it was possible to apply but two sprays during the opening of the blossoms.

METHODS AND MATERIALS

The blossom spray experiments were conducted in Berrien County, Michigan. Test plots of the Rochester variety were established in the John Handy orchard, Sodus, 8 miles inland from Lake Michigan, and of the Halehaven variety at the Franklin Colby orchard, Shoreham, on the Lake Michigan shore. The fungicides used in the blossom sprays were: 1) wettable sulfur (5 pounds in 100 gallons of water) plus a wetting agent, 2) L-8277 (½ pint in 100), 3) L-7752* (½ pint in 100), 4) L-8299* (½ pint in 100), and 5) liquid lime-sulfur (2 gallons in 100). The wettable sulfur and L-8277 sprays were arranged in a factorial design to evaluate the effectiveness of each application in relation to weather conditions.

HANDY ORCHARD

The first application was made on April 30 when 25 percent of the blossoms were open or had their stigmas exposed. The following day, May 1, 0.4 inch of rain fell in intermittent showers. The second spray was applied on May 3 when all of the blossoms were open. Counts of blossom blight made 10 days later showed only 1.1 percent of the blossoms infected on the unsprayed trees.

The blossom sprays gave from 30 to 100 percent control, according to the data presented in Table 1. It is apparent from the results that the second spray on the Handy plots was ineffective and might well have been omitted. The ineffectiveness of this spray is demonstrated by the following fact: The incidence of blight in both the L-8277 and wettable sulfur plots receiving two applications was not materially below that of the plots receiving the first spray alone. This could have been anticipated since the first spray was applied the day prior to the rain. Although the amount of potential inoculum was very great as evidenced by the large numbers of spore-discharging apothecia on the ground, it is believed that low humidities following the rain inhibited spore germination and fungous growth. At the same time, high tem-

*Experimental sprays of The Standard Oil Company (Indiana).

peratures forced the blossoms to reach their resistant stage (petal fall) rapidly—thus preventing higher percentages of blight.

COLBY ORCHARD

The Colby orchard, adjacent to the Lake Michigan shore, blossomed later than the Handy orchard. The first spray was applied on May 2 when 28 percent of the blossoms showed exposed stigmas. The second spray was applied on May 4 when the trees were in full bloom.

From the results of the blossom blight counts, it is apparent that the rain of May 1 did not contribute to infection in the Colby orchard, and this coincides with the fact that closed blossoms are very resistant. The infection occurred after the second spray and presumably was

TABLE 1—*Reduction of blossom blight by sprays on the Halehaven variety (Colby Orchard) and Rochester Variety (Handy Orchard)*

Rochester Variety—Handy Orchard

Material	Application	Blossoms counted (number)	Blight	Relative control (per cent)
L-8277	first	3000	0.75	32.4*
L-8277	second	4000	1.5	**
L-8277	both	4000	0.75	32.4
Wettable sulfur	first	3000	0.33	70.3
Wettable sulfur	second	4000	1.5	**
Wettable sulfur	both	4000	0.5	54.9
Liquid lime-sulfur	both	1000	0.1	91.0
L-7752	both	1000	0.0	100
L-8299	both	1000	0.0	100
Non-sprayed	.....	9000	1.11	.....

Halehaven Variety—Colby Orchard

Material	Application	Blossoms counted (number)	Blight	Relative control (percent)
L-8277	first	3000	1.1	79
L-8277	second	4000	0.6	89
L-8277	both	4000	0.7	87
Wettable sulfur	first	3000	1.4	73
Wettable sulfur	second	4000	0.7	87
Wettable sulfur	both	4000	0.4	92
L-7752	both	1000	0.0	100
L-8299	both	1000	0.2	96
Non-sprayed	.....	8000	5.3	.....

*Percentage determined by: $100 - \left(100 \times \frac{\text{treated}}{\text{untreated}}\right)$

**More blight than non-sprayed.

favored by the high humidities and misty atmosphere in the immediate vicinity of the lake. Although the residue of the first spray was retained long enough to protect the 28 percent of blossoms that were open, the second spray alone, protected not only the analogous 28 percent but also the blossoms which opened later.

The difference in the amount of blossom blight in the non-sprayed plots of the Colby orchard, 5.3 percent, and the Handy orchard, 1.1 percent, could not be attributed to different amounts of potential inoculum. Each orchard had an abundance of spore-discharging brown rot apothecia and an equivalent amount of twig cankers and mummies in the trees. The low incidence of blossom blight in both orchards, therefore, did not result from a lack of inoculum but was clearly the result of weather factors unfavorable for infection.

COMPARISON OF MATERIALS IN CONTROL OF BLOSSOM BLIGHT

There were some differences in the results obtained. In both orchards the greatest reduction of blossom blight was in the plots sprayed with the Standard Oil Company experimental fungicides L-7752 and L-8299. The percentages of blight, however, were based on fewer blossoms counted than in the case of the plots sprayed with wettable sulfur and L-8277. Wettable sulfur was somewhat superior to L-8277 in the Handy orchard, but there was little difference between the effectiveness of the two fungicides in the Colby plots. The application of liquid lime-sulfur at the Handy orchard resulted in better control than wettable sulfur, but again the count was based on fewer blossoms. Even though the temperature reached 98° F. (unofficial temperature at the orchard), 2 gallons of liquid lime-sulfur in 100 gallons of water caused no evident injury to the blossoms or the fruit set.

SUMMARY AND DISCUSSION

Blossom blight control experiments showed the importance of a protective spray on the exposed blossoms just prior to a rain or periods of high humidity. Sprays applied several days after infection had occurred were of little or no value. Blossom blight is a function of the number of spores present and wet weather when the open blos-

soms are less than five days old, at which time they are most susceptible to infection. Even though large numbers of spores are present, there will be little blossom blight if dry conditions prevail, or in wet weather if there are few spores present. In these experiments wettable sulfur appeared slightly superior to L-8277 as a fungicide for the blossom sprays. The two experimental materials of the Standard Oil Company and liquid lime-sulfur showed promise.

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PROBLEMS CREATED FOR THE DAIRY INDUSTRY BY ANTIBIOTIC MASTITIS TREATMENTS

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THE DISCOVERY of penicillin by Fleming (4) in 1929 and its comparative lack of irritation when administered to human beings were followed by the early reports of Kakavas (7) and Bryan, Huffman and Horwood (2) concerning its usefulness in the treatment of infectious mastitis. The therapeutic value of penicillin was greatly enhanced by the low degree of irritation resulting to the udder following udder infusion. Since these early reports many papers have been presented to confirm the value of penicillin and other antibiotics, such as streptomycin, aureomycin, chloromycetin, bacitracin, neomycin, tyrothricin, terramycin, and others in the treatment of infectious mastitis. If the milk from the treated quarter is included in the herd supply, the penicillin finds its way into market milk; the only way to prevent this from occurring is to withhold the milk from the treated quarters.

PENICILLIN MILK LEVELS FOLLOWING THE USE OF PENICILLIN IN THE UDDER

Since penicillin has become the product of choice for the treatment of many forms of infectious mastitis, it is not surprising to find that a number of new medication forms have appeared on the market. The data of Table 1, by Jackson and Bryan (5), present the penicillin milk levels obtained by the use of some of these products. To keep penicillin out of market milk, every dairyman should be advised to discard the milk from the treated quarters for 3 days following treatment when crystalline penicillin or penicillin in bougie or ointment form has been used, and up to 8 days when procaine penicillin in oil is used for udder infusion.

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PENICILLIN LEVELS OF HERD MILK

During the past several months 27 samples of herd milk have been collected at random at several milk plants and checked for penicillin levels. The presence of the drug was suspected in only one case

TABLE 1—*The penicillin milk levels following the administration of various penicillin products and dosage levels to cows during the middle of lactation*

Medication forms	Units of penicillin used	Units of penicillin per cc. of milk*; days after the administration of penicillin									
		1	1½	2	2½	3	4	5	6	8	9
Penicillin in 10 cc. of water	25,000	1	0.06	—0.06	.....	.....	.....	.....	.....	.....	.....
	50,000	1	0.25	0.06	—0.06	.....	.....	.....	.....	.....	.....
	100,000	4	1	0.25	0.12	—0.06	.....	.....	.....	.....	.....
Penicillin in bougie	25,000	1	0.06	—0.06	.....	.....	.....	.....	.....	.....	.....
	50,000	1	0.12	0.03	—0.03	.....	.....	.....	.....	.....	.....
	100,000	2	0.5	0.03	0.03	—0.03	.....	.....	.....	.....	.....
Penicillin in ointment	50,000	2	1	1	0.5	0.06	—0.06	.....	.....	.....	.....
	100,000	2	1	1	0.5	0.12	—0.06	.....	.....	.....	.....
Procaine penicillin in oil	300,000	40	4	4	.....	2	1	0.5	0.5	0.12	—0.06

*—before a value means less than that amount of penicillin present.

where the milk of a penicillin-treated cow was included in the herd milk, but surprisingly, varying levels were present in 26 of the samples. These data are presented in Table 2; they indicate an apparent promiscuous use of penicillin and the lack of withholding milk from the treated quarters. Dairymen must understand that this penicillin or any other antibiotic presents a problem to the milk plant operator, since pasteurization temperatures do not destroy the potency of the penicillin.

TABLE 2—*The penicillin levels found in 27 herd samples*

Number of samples	Units of penicillin per cc. of milk
1	0.5
5	0.25
7	0.12
10	0.06
3	0.03
1	none

EFFECT OF ANTIBIOTICS ON THE MANUFACTURE OF FERMENTED DAIRY PRODUCTS

A number of reports have been made of specific instances in which antibiotics have adversely affected the production of certain dairy products (1, 6, 8 and 9). Some of these reports are:

1. The presence of 0.5 unit of penicillin per cc. of milk resulted in complete inhibition of acid production by six starter cultures.

2. The presence of 0.1 unit of penicillin per cc. of milk resulted in marked inhibition of acid production by six starter cultures.

3. The presence of 0.05 unit of penicillin per cc. of milk resulted in moderate inhibition of acid production by six starter cultures.

4. The presence of 0.0005 mg. of aureomycin per cc. of milk resulted in marked inhibition of acid production.

5. The presence of 0.00005 mg. of aureomycin per cc. of milk had almost no effect on the fermentation.

6. The presence of as little as 1 percent of milk or cream from a treated quarter resulted in a restriction of acid production for from 4 to 6 milkings after treatment. Sulfanilamide, sulfamerazine and aureomycin were slightly less restrictive in action.

7. Lactic acid bacteria were restricted in growth and acid production in reconstituted milk where the milk powder was manufactured from milk containing at least 1 percent of milk from recently treated quarters. Under these circumstances sulfanilamide, sulfamerazine and aureomycin exerted a slightly stimulating effect on the lactic acid bacteria.

8. When the milk from one treated quarter (75,000 units of penicillin) was mixed with the milk from 20 untreated cows, starter cultures were greatly inhibited.

The inhibition of starter cultures seriously affects the production of cottage, cheddar and other cheese, buttermilk and butter made from ripened cream. To produce products of high quality, the milk from recently treated quarters must be withheld from the herd milk. A minimum 3-day withholding period is suggested as adequate in most cases.

DOES THE PRESENCE OF ANTIBIOTICS IN MILK HAVE ANY EFFECT UPON THE CONSUMER?

At present no specific answer can be given to this question. Felsenfeld (3) indicates that when penicillin first became available for human use physicians found that about 3 percent of their patients reacted unfavorably to penicillin. Today he reveals that approximately 10 to 12 percent of children—not previously given penicillin by injection—are sensitive to penicillin. Is it possible that penicillin in the milk consumed by these children may play a part in this reaction?

ANTIBIOTICS AS AN AID IN A MASTITIS CONTROL PROGRAM

The following five items must be considered and applied, in the order given, in a successful mastitis prevention and control program:

A. Good, sanitary milking procedures.

1. Arrange and/or milk cows in following order: healthy, suspicious and infected.
2. Discard the foremilk into a strip cup, exclude from supply all abnormal milk.
3. Wipe the udder of each cow with warm (120°F.) disinfect 1 minute before milking.
4. Exclude infected humans from milking cows.
5. Dip teat cups of milker in disinfectant between cows (have milk tube valve in head of machine open).
6. The hands of person milking or stripping should be dipped in disinfectant between cows.
7. Milk each cow regularly, rapidly, and completely for udder health.

B. Good, sanitary herd management procedures.

1. Proper stalls for cows.
2. Prompt treatment of udder and teat injuries.
3. Clean and disinfect stalls upon removal of infected cows.
4. Keep barn and barnyard clean and dry.
5. Raise heifers as disease-free replacements.
6. Early removal of accessory teats.
7. Preferred source of herd replacements: a-home raised heifers, b-purchase of bred heifers, c-purchase of milking cows—test before purchase.

C. Early and accurate diagnosis.

1. Physical examination of each cow's udder.

2. Bacteriological test to determine if infection is present or absent.

D. Elimination by slaughter or complete segregation of infected cows with badly damaged udders.

1. Such cows usually do not respond to udder infusion treatments.

2. This eliminates or confines the source of infection.

E. Early and proper treatment.

1. A high percentage of cows, without marked change in the udder, recover by udder infusions.

2. Udder infusions are of value only where infection is the cause of the mastitis.

3. Control measures must accompany treatment or recovered case may become reinfected.

Mastitis treatments are of value only when improvements are made in the management procedures; if such changes are not made, the treatments are relatively ineffective.

SUMMARY

The promiscuous use of antibiotics in the treatment of mastitis, without withholding the milk from the treated quarters, results in trouble for the dairy manufacturing industry. The milk from treated quarters should be withheld from the main supply for at least 3 days.

Pasteurization of milk does not destroy the antibiotics commonly used in the treatment of infectious mastitis.

Observations suggest that the ingestion of penicillin in the milk may play a part in the increased number of human beings who are sensitive to penicillin injections.

Antibiotics are an aid to a mastitis prevention and control program. Good, sanitary milking and herd management procedures are basic to udder health.

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FARM PRACTICES AND EGG QUALITY: PART I FACTORS AFFECTING QUALITY OF NEW LAID EGGS

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DEPARTMENT OF POULTRY HUSBANDRY

THE PRODUCER'S JOB in marketing eggs is to carry out those management and handling practices which will result in a maximum number of high quality eggs. A survey in 1949 indicated wide differences in flock management practices and egg handling methods between farms. A study of egg grading station records (from many of these same producers) revealed definite seasonal variations in the egg quality factors as well as wide variations in quality between farms, (Dawson *et al.*, 1949, 1950). Hence, it was believed that a study of the relationship between egg quality and farm practices might reveal ways in which many producers could improve quality of eggs, and increase returns from their farm flocks.

Differences in candled quality from the standpoint of interior quality and shell quality have been attributed to a number of factors. Poultrymen usually attribute their egg quality differences to feeds or feeding practices, or to seasonal differences such as temperature and humidity. These factors as well as genetic factors, age of birds, egg handling practices, and environmental conditions have been studied under laboratory conditions. However, the effects of many of these factors on egg quality and decline in egg quality have not been clearly understood.

The present study was undertaken to evaluate the effects of the factors of egg production and handling on the quality of new laid eggs and the decline in quality at the farm level. A carefully controlled laboratory experiment would probably yield more precise results by analyzing one factor at a time. However, certain advantages are acquired by studying the actual farm conditions and practices which could not be duplicated in the laboratory. Variations in flock management, egg handling practices, and environmental conditions were observed. These observations may be very useful in poultry extension programs as well as in planning further research experiments.

[1]Part II, "Factors Affecting Decline in Egg Quality at the Farm" will be printed in a future issue.

ARTICLE 33-30

PROCEDURE

This report includes data collected from 22 farms in three different areas of Michigan. Although a majority of the eggs studied were from farm flocks in Allegan County, eggs from five flocks in Tuscola and five flocks in Isabella County were studied for comparisons.

Table 1 shows the frequency distribution of the breeds and varieties kept on the cooperating farms, as well as the number of strains of each breed. A majority of the flocks were White Leghorns.

TABLE 1—*Breed and strain classification of the flocks studied*

Breed	Number of flocks	Number of strains
White Leghorn	13	5
Rhode Island Red	2	2
Barred Rock	3	1
Legorca	1	1
Wyandottes	1	1
Red Rock Cross	1	1
Mixed flock	1	..
	22	11

All farms were visited once each month for a period of one year. Each of the farms in Allegan County were visited during the period from May 1949 to April 1950. Farm visits were started in September in Tuscola County and in October in Isabella County. Two of the flocks in Tuscola and two in Isabella County were sold during the study; hence records are not complete for those farms.

Twenty-four eggs were purchased from each farm visited each month. Half of the eggs from farms in Allegan and Tuscola counties had been laid the day of the visit and the remainder were 24 hours old. A portion of the eggs obtained in Isabella County were new laid, the remainder ranged from 1 to 6 days of age.

All eggs in this study were candled for quality and then broken on a glass plate for broken-out quality measurements and observations. The following observations and measurements were made:

a. Egg weight
b. Shell condition
c. Visual Cornell Score[2]
d. Albumen height

[2]Cornell Score is a subjective measurement based on photographic standards for broken out egg quality. Smallest numbers represent best egg quality.

e. Calculated Haugh Score[3]
f. Presence of foreign material

Each of the farmers cooperating in the study was asked to keep certain records concerning his flock management and egg handling practices. Appendix Table A illustrates the forms used for keeping these records. Some farmers kept fairly accurate and complete records. However, a number of the records were not complete enough for use in this analysis.

All of the information requested had some bearing on either the quality of eggs marketed or the labor required to produce and maintain high quality eggs.

RESULTS

LEVEL OF NEW LAID EGG QUALITY

Egg quality as determined by candling was lowest in August (71 percent AA) and highest in April (91 percent AA). The average for the year was 81 percent AA quality. The percentage of AA eggs increased fairly consistently from September to April then declined very rapidly to August. Albumen quality (eggs broken-out as the housewife sees them) was highest in October and declined consistently, but slowly throughout the year. Figure 1 shows the seasonal variation of both the candled and the broken-out quality of the eggs observed. The apparent difference in quality as determined by these measurements may have been due to differences in the temperature of eggs when candled or to some other unobserved factor.

Figure 2 shows that the distribution of Haugh Scores is skewed. Seventy percent of these new laid eggs had scores between 80 and 100. Only 5 percent had scores of 100 or over, while the remainder had scores ranging down to 30. Although most eggs are of excellent quality when laid, a small percentage have very watery albumens.

Not all of the poor quality eggs were detected by candling. Although there was a direct relationship between the average Haugh Score and the candled quality the range in Haugh Scores was about the same for AA quality and A quality (Table 2). None of the eggs candled as B or C quality had scores larger than 89, while some of both AA and A quality eggs had scores over 100. This indicates that our present candling method is more effective in accurately estimating interior quality of the lower quality new laid eggs.

[3]Haugh Score is an objective measurement of quality based on thickness of firm albumen, with a correction applied for egg weight differences. Largest numbers represent best egg quality.

TABLE 2—*Frequency distribution of Haugh scores of 2,526 new laid eggs grouped according to candled quality*

Haugh Score	Candled quality									
	AA		A		B		C		Total	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
30 - 39....	3	0.1	2	0.4	1	9.1	0	0	6	0.2
40 - 49....	4	0.2	8	1.7	3	27.3	0	0	15	0.6
50 - 59....	19	0.9	17	3.7	1	9.1	0	0	37	1.5
60 - 69....	94	4.6	55	11.9	3	27.3	0	0	152	6.0
70 - 79....	309	15.1	111	24.1	2	18.2	1	50	423	16.8
80 - 89....	829	40.4	160	34.7	1	9.1	1	50	991	39.2
90 - 99....	675	32.9	99	21.5	0	0	0	0	774	30.6
100 - 109...	118	5.8	9	2.0	0	0	0	0	127	5.1
110 - 119...	1	0	0	0	0	0	0	0	1	0

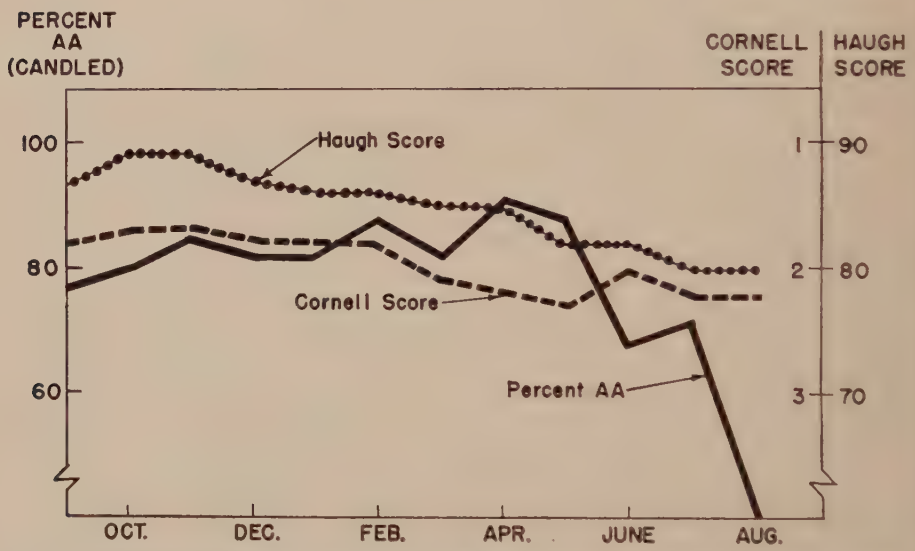

Fig. 1. Seasonal variation in egg quality as determined by candling and broken-out measurements.

A second quality factor with considerable economic importance to poultrymen is the strength or condition of the shell. Although no objective measurements of shell strength were made, a record was kept of all checked and apparent poor shelled eggs. Figure 3 shows the seasonal variation in shell condition. Shell quality remained approximately the same (5 percent poor quality) from September to April then increased sharply to July and August. This is probably the result of two factors: increasing age of birds and higher temperatures in the summer months.

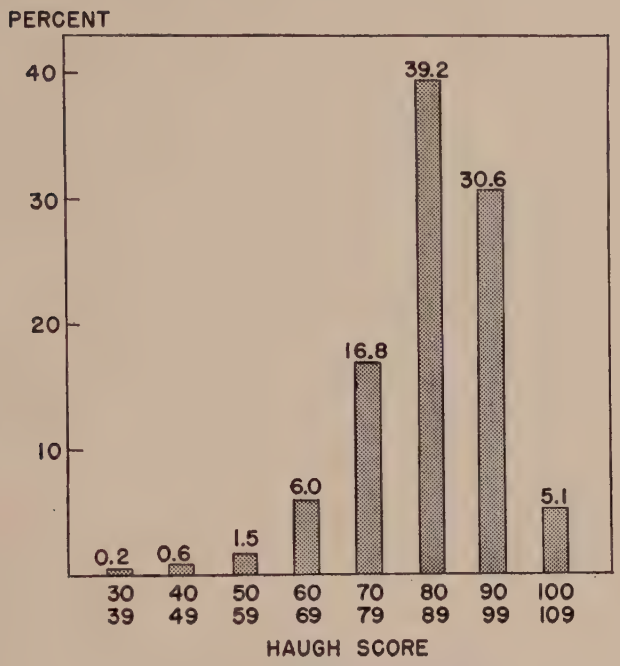

Fig. 2. Frequency distribution of Haugh scores of 2,526 new laid eggs.

Figure 3 also shows variations in a third egg quality factor, namely, the incidence of blood and meat spots. The data presented here includes all spots observed in the broken-out eggs, most of which were not detected by candling. Blood and meat spot incidence increased from approximately 15 percent of all eggs in the fall to 25 percent in the summer months. The number of spots large enough to be detected by candling and which would be definitely objectionable for all housewives was 2 to 3 percent of all eggs.

EGG QUALITY DIFFERENCES AMONG BREEDS

The question of differences in egg quality among breeds has always been subject to debate. In this study the number of flocks sampled, other than Leghorns, was relatively small; hence, these results may not accurately represent the total chicken population. However, certain indications of breed differences were apparent.

Table 3 shows the egg quality differences both in and out of the shell. Candled quality of the Leghorn eggs (white-shelled) was slightly below that of all breeds producing brown-shelled eggs. This

may have been an apparent difference due to color of shell and not to difference in the actual factors considered in placing eggs in one quality classification or another. However, when comparing the broken-out albumen quality (Haugh Score) of the different breeds one finds that the candling score follows very closely the broken-out measurements. In the summer when quality is usually at its lowest, there is a close direct relationship between candling score and broken-out score. Leghorn eggs had the lowest broken-out score, followed by Rhode Island Reds, with Barred Rocks highest. Because these flocks did not come into production at the same time, and quality declines with age of birds, this evidence is not conclusive of breed differences, but merely indicates that under the conditions of this study some differences do exist.

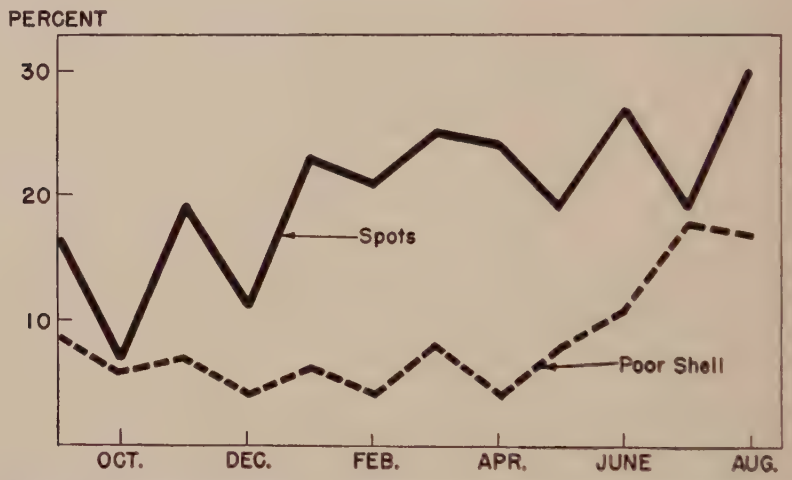

Fig. 3. Seasonal variation in percentage of poor shelled eggs and in percentage of spots found in broken-out eggs.

The percentage of eggs with poor shell quality was lowest in the fall and highest in the summer. Twenty-five percent of the eggs from the two flocks of Rhode Island Reds had poor shells in the summer. This was almost twice as large a percentage as any of the other breeds studied. In the fall this difference was not apparent (Table 3).

The incidence of blood or meat spots was considerably higher in all breeds laying brown-shelled eggs than in the Leghorns. In the summer when this incidence was highest, 12 percent of the Leghorn eggs had spots, while 37 percent of the Rhode Island Red eggs and 47 percent of the Barred Rock eggs had some spots (Table 3). The

incidence of spots detected by candling was about the same for each breed.

TABLE 3—*Relationship between breed and certain egg quality factors—fall and summer seasons*

	Leghorn	Rhode Island Reds	Barred Plymouth Rocks	Others
FALL				
Number of flocks	10	2	3	4
Candled Index*	3.7	3.9	3.8	3.8
Haugh Score	88	89	93	87
Percent poor shell	7.5	10.8	8.3	10.8
Percent with spots	8.3	20.8	29.2	28.3
SUMMER				
Number of flocks	11	2	2	4
Candled Index*	3.5	3.6	3.7	3.7
Haugh Score	79	80	84	82
Percent poor shell	14.2	25.0	13.3	12.5
Percent with spots	12.5	37.5	47.5	41.7

*Candled Index: AA=4, A=3, B=2, C=1 (Interior quality only).

EGG QUALITY DIFFERENCES AMONG STRAINS

The data obtained from the 13 flocks of Leghorns were analyzed for strain differences. Table 3 shows a summary of the egg quality differences between strains for a year. Average Haugh Score varied from 85.6 to 77.9. Percentage of poor shelled eggs varied from 5 percent to 9.8 percent. Incidence of spots varied from 5.8 percent to 13.3 percent.

TABLE 3—*Relationship between strain of White Leghorns and quality of eggs produced*

	Strain				
	A	B	C	D	E
Number of flocks	4	6	1	1	1
Average Haugh Score	85.6	84.6	81.5	80.4	77.9
Percent of poor shell	9.8	9.0	5.8	8.8	5.0
Percent of spots	6.3	11.0	8.1	13.3	5.8

In these strains the strain with poorest albumen quality had the best shells and fewest number of spots. Some of these egg quality factors, however, are influenced by feed and feeding practices and other conditions such as temperature and humidity which were not similar on all farms.

DISCUSSION

ALBUMEN QUALITY

Several factors influencing the albumen quality of the egg at the time it is laid have been investigated. In view of the preponderance of positive data, the inheritance of egg quality characteristics has been definitely established. Knox and Godfrey (1934, 1938, 1940) and Lorenz *et al.* (1934, 1940) established the inheritance for percentage of firm albumen, and Van Wagenen *et al.* (1936, 1937) established the inheritance for albumen score. Different investigators have used different criteria for measuring quality, but conclusions have been similar. Results of our study showed considerable differences in Haugh Score and albumen score among breeds and strains, indicating inherent differences.

The effect of age of bird on albumen quality as shown in this report has been previously established. Wilhelm and Heiman (1938) presented data on seasonal changes in albumen quality which reflected the effects of increasing age of birds. Jeffrey (1941) distinguished between age of bird and seasonal variation and showed that albumen quality declined with age of bird.

The effect of feed on albumen quality was not attempted in this study. However, many investigators have shown little relationship between albumen quality and feed or feeding program. Card and Sloan (1934, 1935) and Denton and Titus (1941) obtained no significant results in studying the effect of feed on albumen quality. Heiman *et al.* (1936) presented data showing that birds on diets with less than 14 percent protein, (all vegetable) produced eggs with higher albumen index than did birds on diets of higher protein levels (partly animal). However, these birds on the lower protein diet produced smaller eggs, hence differences would have been less with other albumen measurements.

SHELL QUALITY

Variations between flocks in shell strength are due mainly to hereditary, nutritional, and other factors that influence the proportional weight and thickness of the shell. This report showed progressively poorer shells as the age of the hens increased. Percentage of poor shelled eggs was greatest in the summer months. Heuser and Norris (1946) presented data showing that breaking strength is lower in July and August than during the winter, substantiating results of this trial. The seasonal decline in thickness is probably associated with a rise in temperature (Wilhelm 1940). Variation in the breaking strength of egg shells has been attributed to the content of some minerals and vitamin D in the diet. Buckner and Martin (1920) reported that a lack of an adequate calcium supply, which the hen can assimiliate, will produce smaller and thin-shelled eggs. Experiments reported from Cornell (Caskey and Norris 1938) show that breaking strength of eggs is also related to the quantity of manganese in the diet. Taylor and Martin (1928) reported that a lack of sufficient amounts of vitamin D produced thin or soft-shelled eggs.

Normally each bird secretes a fairly constant amount of shell material on her eggs, the thickness being a manifestation of calcium metabolism. Taylor and Lerner (1939) established two lines of hens, "thick-shelled" and "thin-shelled", but were unable to demonstrate clear-cut genetic factors. Our study also showed indications of inherent differences between breeds and strains in egg shell quality.

BLOOD AND MEAT SPOTS

Blood spots appear as dark red spots or streaks when the eggs are candled. When the similar spots appear somewhat browner the term "meat spots" is usually used. Recent studies have shown that most, if not all, so-called meat spots are blood spots which have become darkened due to decomposition (Nalbandov and Card, 1944). Results reported in this paper showed striking differences among breeds in incidence of blood spots. The Leghorn eggs observed had the lowest incidence of blood spots and the "heavy" breeds the highest incidence. Quinn and Godfrey (1940) obtained similar results when observing eggs from Rhode Island Reds and Leghorns.

Blood spots have often been attributed to fright of the birds. Jeffrey and Pino (1943) found no significant increase in blood spots

after allowing a dog to chase a flock for 5-minute periods several times a day.

It is still not known why there are individual or breed differences in blood spot incidence. The extent which heredity and environment affect occurrence of blood spots has not been determined, but evidence points to heredity as one of the more important factors influencing their occurrence. Diet may also have some effect, since blood spot incidence was reduced when hens were allowed on range (Nalbandov and Card, 1944).

Evidence presented in this paper showed a seasonal variation in incidence of blood spots and substantiates at least in part, results of Lerner and Smith (1943). They reported an increase in frequency of spots after April.

SUMMARY

1. A definite seasonal change in albumen quality was observed. The Haugh Score (objective measurement) showed the most uniform decline from fall to summer. Candled quality (subjective measurement) actually increased from September to April while the Haugh Score declined consistently after October. This decline was probably due to both seasonal changes and increased age of the flocks.

2. Incidence of blood and meat spots increased erratically from October through August. This increase averaged more than one percent a month throughout the year.

3. The egg shell quality (subjective measurement) remained relatively constant from September to April, then decreased sharply in the summer months. This decrease was probably due to age of flock and environmental conditions.

4. Greatest breed differences were observed in incidence of blood and meat spots. Leghorn eggs had lowest frequency of spots and Barred Rocks highest. As a group the heavy breeds produced a much higher incidence of spots.

5. Considerable differences in albumen quality, blood spot incidence and shell quality were observed between five strains of Leghorns. However, the number of flocks for three of the strains was too low to draw accurate conclusions.

This is the first of two papers to be submitted covering farm practices and egg quality. The second paper will discuss the factors affecting decline in quality at the farm level.

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APPENDIX TABLE A

FORMS USED BY POULTRYMEN FOR RECORDING THE INFORMATION REQUESTED

Month of.....19.....Farm No.....Pen No.....

HEN HOUSE PRODUCTION RECORD

Day of month	Number of eggs gathered					Minutes to gather eggs	Number dirty eggs	Number floor eggs	Eggs broken in nests
	Before 10:00	10:00 to 12:00	12:00 to 2:00	2:00 to 4:00	After 4:00				

EGG ROOM RECORD

Day of month	Total eggs	Number dirty	Number washed	Number brushed	Number broken	Minutes cleaning	Eggs cased	Minutes casing

FEED AND LITTER RECORD

Day of month	Pounds of feed					Cleaning pen		Cleaning nests	
	Corn and wheat	Oats	Mash	Shell	Grit	Time spent	Litter used	Time spent	Amount litter used

PASCAL CELERY VARIETIES IN MICHIGAN

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BECAUSE OF increasing interest among Michigan celery growers in the production of green (Pascal type) celery, performance tests of many available varieties and strains have been conducted during the past two years. The results obtained in 1949 have been reported (2). This paper summarizes observations of Pascal celery varieties in Michigan and presents data pertinent to the performance of several "Summer" and "Utah" Pascal types grown during the 1950 season on the Michigan State College muck experimental farm near East Lansing, Michigan.

Greenhouse seeding dates for the summer crop and late Utah types were March 29 and April 14, respectively. Plants were set in the field on May 30 for the earlier varieties and on June 14 for the late Utah types. With each of the two variety plantings, six randomized blocks were utilized, thus allowing for duplicate blocks each of the 4-, 6- and 8-inch spacings. Each variety within a block occupied 8 feet of row length. Accordingly, the number of plants of a given variety in a block varied and was dependent on the spacing used. Distance between rows was 32 inches. Commercial fertilizer consisting of 1500 pounds of 0-10-30 plus 500 pounds of salt per acre was applied broadcast and worked into the soil prior to setting the plants. Approximately 3 weeks following transplanting, a side dressing of 150 pounds of ammonium sulfate per acre was applied.

Temperatures during June, July, and August averaged 2-5 degrees below normal, and high yields of excellent quality celery were produced. Rainfall was sufficient to maintain the water table between 19.5 and 32 inches below the surface, and irrigation facilities were utilized only following field setting of the plants. The celery was dusted weekly until 3 weeks prior to harvest with a tri-basic copper fungicide, but no blight symptoms became apparent on any varieties even after dusting was discontinued. The summer crop was harvested August 4, and the late Utah types on September 1.

ARTICLE 33-31

Replicated samples of each variety at the 4- and 6-inch spacings were packed in half crates and placed in a storage room held at a temperature which ranged from 32° to 35° F. and a relative humidity of 92 to 98 percent. After one month the relative storage quality of all varieties grown at the 4- and 6-inch spacings was arbitrarily rated as to general appearance and taste.

The Summer and Utah celery varieties included in the trials are listed in Tables 1 and 2. Yields in crates per acre of trimmed stalks, the percentage of trim, the weight of trimmed stalks, petiole lengths, petiole counts, and comparative storage quality are presented for each variety. Varieties are arranged in order of total yield of trimmed stalks. Yield, percentage trim, and weight per stalk were obtained by averaging values for the 4-, 6- and 8-inch spacings. Petiole lengths were determined by averaging the values for the lengths of the second shortest petiole on the faces of the stalks, while the count was obtained by recording the total petioles seen in a cross-section of the stalk made 4 inches above the butt.

Several items are of interest in the performance of the various varieties as shown by the data in Tables 1 and 2. With the summer types, highest yields were obtained with Earligreen and Sweetheart. These varieties, however, have very short and flattened stalks. Cornell 619 (a selection out of a cross between Cornell 6 and Cornell 19) and Cornell 19 are excellent Golden Pascal types for Michigan. A 2 years' performance test of Cornell 619, as compared with Cornell 6 and 19, indicates that it is superior to both its parents. Hybrid celery 654, also included in the Utah type trials, is an Earligreen type of good quality. Although it generally has good length and fair heart development, individual plants show considerable variability (7-12 inches) in petiole length. It was of interest to note that this variety when grown with the later Utah planting developed both a longer stalk and larger heart (Table 2). Of the Summer Pascal or Fordhook types, Tall Fordhook (Fig. 1), Volantes, Burpee, Gunson's 2, and Ferry-Morse (Waltham) strains gave a comparable performance. Some differences, however, can be noted in storage quality. As is apparent, considerable variability existed among the strains of Summer Pascal. Florida Green Pascal (Table 2), mistakenly included in the Utah type planting, compared favorably with the better strains of Summer Pascal listed in Table 1.

TABLE 1—*Comparative performance of summer celery varieties grown at East Lansing, Michigan, 1950*

Variety	Source	Yield per acre	Percent trim	Weight per stalk	Petiole length	Petiole count	Storage quality†
		(crates*)		(pounds)	(inches)		
Earligreen	Grand Rapids Growers	889	39.9	2.18	6.6	12.4	1
Sweetheart	Ferry-Morse (31597)	861	41.8	2.11	6.3	11.8	1
Cornell 619	N. Y. Agr. Exp. Sta.	828	47.6	1.93	9.3	9.8	2
Hybrid Celery 654	Michigan State College	823	41.2	2.00	9.7	10.8	1
Cornell 19	Ferry-Morse (31567)	785	41.9	1.83	8.2	9.8	2
Earligreen	Ferry-Morse (8438)	763	43.0	1.95	7.8	11.8	1
Tall Fordhook	Eastern States Farmers' Exchange	755	40.0	1.71	8.2	9.9	3
Summer Pascal	Volantes Strain	741	38.2	1.75	7.6	9.4	1
Fordhook	Burpee	736	38.7	1.73	7.9	9.7	1
Summer Pascal 2	Gunson	727	40.5	1.74	8.2	9.3	2
Summer Pascal—Waltham Strain	Ferry-Morse (8452)	711	41.6	1.70	7.9	9.1	2
Summer Pascal	Woodruff	673	41.9	1.63	7.4	8.8	2
Summer Pascal 1	Gunson	668	43.0	1.65	7.6	8.1	2
Summer Pascal 5	Ferry-Morse	653	40.5	1.55	7.6	8.8	1
Emperor	Ferry-Morse (4373)	651	45.0	1.63	8.1	8.5	1
Fordhook	Woodruff	520	52.2	1.42	7.5	7.9	3
Differences Necessary for Significance at 5%		79	4.3	.16	1.7	1.0	.....
Differences Necessary for Significance at 1%		109	5.9	.21	2.3	1.7	.....

*65-pound celery crates.
†1—Best.
3—Poorest.

TABLE 2—*Comparative performance of Late Utah type celery varieties grown at East Lansing, Michigan, in 1950*

Variety	Source	Yield per acre	Percent trim	Weight per stalk	Petiole length	Petiole count	Storage quality†
		(crates*)		(pounds)	(inches)		
Superior Pascal	Grand Rapids Growers	944	44.6	2.21	9.9	15.5	1
Utah 16	Associated (57099)	927	49.1	2.35	10.2	16.2	1
Utah 10B	Ferry-Morse (8449)	919	45.0	2.34	9.7	16.4	1
Utah Certified	Sluis and Sons	905	46.9	2.24	10.0	13.6	3
Utah 6	Gunson	900	49.5	2.30	9.4	14.2	1
Pascal Superb	Corneli	894	45.8	2.60	10.0	15.0	2
Hybrid Celery 654	Michigan State College	892	44.8	2.34	10.1	13.3	3
Utah 15	Ferry-Morse (8450)	878	50.8	2.32	9.4	13.7	2
Utah Jumbo	Gill Bros. (7076)	873	48.9	2.17	9.3	15.5	2
Growers Pascal 49	Grand Rapids Growers	864	47.9	2.20	8.8	15.2	1
Special Utah 50	Aggeler-Musser	864	48.3	2.16	9.1	16.1	2
Utah	Ferry-Morse (72987)	851	46.6	2.20	8.7	13.6	3
Vande Bunte Pascal	Vande Bunte Bros.	845	52.1	2.23	9.0	14.5	2
Utah	Nishiguchi Selection (Utah)	831	49.4	2.17	8.9	14.1	1
Utah	Pollard Selection 1 (Utah)	831	49.8	2.27	9.8	15.3	1
Special Utah	Aggeler-Musser (70015)	826	53.0	2.23	10.1	16.4	2
Utah Special	Gill Bros. (6348)	826	51.7	2.10	10.2	15.3	1
C and L Utah	Aggeler-Musser (69511)	798	46.3	2.03	8.8	13.8	2
Woodruff's Beauty	Woodruff (36653)	798	52.2	2.21	8.1	16.8	3
Everglades Pascal	Corneli	785	50.0	1.90	9.1	14.0	3
Non-Bolting Green	Ferry-Morse (9378)	782	51.0	2.05	7.1	12.6	1
Florida Green Pascal	Associated (57099)	739	40.4	1.93	9.0	10.7	4
Non-Bolting Green	Ferry-Morse (7437)	716	46.7	1.86	8.0	12.5	1
Utah or Golden Crisp	Burpee (276)	689	47.3	1.89	9.2	11.9	3
Giant Pascal	Ferry-Morse (29768)	656	55.1	1.73	13.1	9.4	4
Differences Necessary for Significance at 5%		96	6.1	.21	.6	1.7	.....
Differences Necessary for Significance at 1%		129	8.3	.28	.8	2.3	.....

*65-pound celery crates.
†1—Best.
4—Poorest.

Fig. 1. Productive strains of Pascal celery for Michigan. Top, Tall Fordhook, bottom, Superior Pascal (similar to Utah 16 and Utah 10B). Note apparent lack of uniformity and short petioles in Tall Fordhook as compared with Superior Pascal. Both varieties are faced in 16-inch half crates.

Variability in the performance of the various Utah Pascal types is apparent in Table 2. Actually no significant differences are evident in the yields of the first 10 or 12 varieties listed. Other factors, such as weight of trimmed stalks, petiole length, count, and storage quality, should be considered. Superior Pascal, Utah 16, and Utah 10B have the best over-all record and showed unusual plant uniformity (Fig. 1), A similar performance record has already been noted for Superior Pascal (2). The foregoing three varieties probably originated from a common stock and, irrespective of their relatively greater susceptibility to leaf blight diseases, are suggested as a Pascal type which needs greater commercial consideration if locally grown Pascal is to be comparable in quality to Western celery. Varieties, such as Utah Certified, Utah 6, Utah 15 Utah Jumbo and Utah Special, are being successfully grown in Michigan. Several other varieties are apparently well adapted but do not have either sufficient petiole length or heart development. Many growers and the market prefer a longer celery and a bigger stalk than presently characterizes much of the Pascal grown in Michigan.

In Table 3 some effects of 4-, 6-, and 8-inch spacings of plants in the row are summarized for both crops. Yields are significantly reduced by wider spacings, and the percentage of trim is increased. However, the percentage of marketable stalks, and the size (weight) of trimmed stalks are reduced when plants are given a 4-inch spacing. Statistical analyses of the data for yield, percentage of trim, and size of stalk, as well as observed plant performance, suggested no significant interractions of spacing with variety in any of the Summer or

TABLE 3—*Effect of spacing on the performance of summer and Utah types of celery*

Spacing	Yield of trimmed celery, crates per acre		Percent trim		Weight per stalk		Percent marketable stalks	
	Utah celery	Summer celery	Utah celery	Summer celery	Utah celery	Summer celery	Utah celery	Summer celery
8-inch	731	643	51.6	44.5	2.51	1.98	97.3	98.6
6-inch	804	686	48.8	44.0	2.10	1.71	94.8	97.3
4-inch	963	985	45.2	38.4	1.82	1.60	89.1	92.0
Difference Necessary for Significance at								
5%	68	68	2.7	2.2	.09	.08	5.3	5.2
1%	162	158	4.2	3.5	.14	.13	12.3	12.0

Utah Pascal types. Storage quality, though not listed separately for each spacing, was definitely affected. After 1 month of storage, crates of all green celery varieties grown at the 4-inch spacing were rated as superior to those grown at 6 inches. The absence of laterals (suckers) and the slightly longer petioles which developed at the 4-inch spacing may have accounted for some of the differences noted in storage quality. Cornell 619 and Cornell 19, golden or ivory Pascal types, unlike the green celery, maintained best storage quality when grown at the 6-inch spacing. Differences in length of stalk (petiole length) and heart development (petiole count) induced by variable spacings were just below the 5 percent level of statistical significance. Generally, however, the tendency was for a slightly longer petiole and smaller count at the 4-inch spacing. For obtaining marketable stalks of green celery as early in the season as possible, close spacings (4-inch), especially with Summer Pascal, may have an advantage in that the stalks develop more upright and are slightly longer.

These results confirm those already reported (1, 2) in that the desirable spacing for Pascal celery grown in Michigan conforms closely to those already used for the production of golden plume and self-blanching types—between 4 and 6 inches. Spacings greater than 6 inches, widely used in some western areas, are not recommended for Michigan.

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THE EFFECT OF FERTILIZER PLACEMENT ON THE YIELD OF ONIONS GROWN ON AN ORGANIC SOIL

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THE EFFECT of the placement of fertilizer on various crops has received considerable attention by workers in the past twenty years. In general, with a number of crops, it was found that if fertilizers were localized in a band close to but not in contact with the seed, the efficiency in the use of the fertilizer was significantly increased. It has also been shown that all crops do not respond in the same way to the placement of the fertilizer.

Approximately 8,500 acres of onions are produced annually in Michigan on the muck soils.[2] Relatively large amounts of fertilizer (1,000-1,800 pounds per acre) are applied to the onion crop, and the bulk of this fertilizer is applied with a grain drill or broadcast, with some subsequent application as a side-dressing. In the report of the tenth annual convention of the Michigan Muck Farmers Association in 1928, Harmer reported on the row-fertilization of muck crops and referred to experimental data obtained as early as 1922. He stated that good results can be obtained from the row application of fertilizer for such crops as onions, celery, cabbage, cauliflower, table beets, carrots, parsnips, potatoes, and sugar beets. As a result of this work and of subsequent work it was established that if fertilizer is placed in a band below but not too close to the seed the efficiency of the use of fertilizer is markedly increased.

Until 1947 this experimental work was carried out either with hand fertilizer applicators or by means of a fertilizer attachment on a garden tractor. First, the fertilizer was placed in the fertilizer distributor of a hand seeder, and then the seed planted in a later operation. Likewise, with the attachment on the garden tractor, the fertilizer was first placed in the soil and then the seed was planted above the fertilizer bands. Variations in the relative placement of fertilizer and

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[2]The term "muck" is used to denote both muck and peat soil.

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seed usually occurs when they are drilled in separate operations; however, the broader aspects of the problem were well defined in these pioneering experiments.

These experiments as a rule were laid out as non-replicated experiments and were conducted on land which, in a number of instances, had been heavily fertilized for several years prior to the time of the experiment. As a result, some of the effect of placement was masked, no doubt by the residual effect of the previous application of fertilizer. In many instances, it was found that 400 pounds of fertilizer placed in a band one inch under the seed apparently gave as effective results as 1,000 pounds of fertilizer applied with a grain drill. In other words, the effect of placement was, in some cases, possibly exaggerated.

Some growers have recognized the value of fertilizer placement for many years; however, until recently no commercial machines were available. One of the first attempts to apply fertilizer in bands under the seed was to close up every other fertilizer opening in grain drills having a fertilizer attachment, thus, placing the fertilizer in bands 14 inches apart. A float with cleats set to follow on top of the fertilizer bands was attached behind the drill, to mark the rows. Then the onion seed was planted in these marks with an onion drill. Later fertilizer-distributor disks were mounted in front of a land roller with seeding units attached to the rear; thus, both the fertilizer and seed could be drilled in one operation. This type of placement drill can now be obtained commercially.

The purpose of a project begun in 1947 was, in part, to construct an experimental machine in which very precise methods of controlling the placement of the fertilizer band could be maintained, and also, to attempt to eliminate the residual effect of previous applications of commercial fertilizer.

The fertilizer placement drill (Fig. 1) described in Volume 32, No. 2, of the Michigan Agricultural Experiment Station *Quarterly Bulletin*, was constructed. This planter and fertilizer-placement equipment is mounted at the rear of a conventional type of a two-plow tractor and is raised by a hydraulic lift. With this machine, it is possible to obtain precise control of the placement of the fertilizer band with respect to the seed. The depth in the soil of the fertilizer band is controlled by a lever with a quadrant so designed that a movement of the lever from one notch to the next either raises or lowers the fertilizer furrow opener exactly one inch.

Fig. 1. Fertilizer placement drill designed for organic soils by agricultural engineers of the U.S. Department of Agriculture, Bureau of Plant Industry, Soils and Agricultural Engineering, and Michigan State College. Drill in raised position for turning: 1) Lever assembly for regulating depth of fertilizer placement, 2) leveling roller, 3) sprocket rack, 4) top-delivery fertilizer hoppers, 5) lever for adjusting spring tension on seeding unit press wheels, 6) self-driven seeding units, 7) clutch assembly for driving fertilizer hoppers, 8) rate change sprocket assembly.

Rates of application can be easily varied from 100 to 2,000 pounds per acre simply by changing the sprockets at as many as four points in the driving system. To further facilitate rate changes, a calibration chart has been prepared, indicating the correct sprocket combination for any given rate. The number of rows and their spacing can be varied from four rows, 14 inches apart, to two rows, 28 inches apart, and other combinations within these limits are possible.

One of the disadvantages of the machine now in use for applying the fertilizer is that a roller follows behind the fertilizer distributor and leaves a very smooth surface after the planting operation is finished. Since a smooth surface is conducive to serious wind erosion, it is planned this year to change the roller in the following manner: Individual rollers, possibly six inches in width, will be constructed and mounted so that they will follow directly behind the fertilizer placement shovel. In this way, only a part of the soil surface will be smooth, and it is hoped that less chance of wind damage will be the result.

This machine has given very excellent reproducible data from season to season, provided maggot injury was not a significant factor.

The crops in the experiments for the years 1947 and 1948 were so badly damaged by onion maggot that the data had to be discarded. It was observed in 1948 that fertilizer placed directly below the seed gave a more uniform growth in the row than that placed 2 inches below and 1½ inches to the side of the seed.

In 1948, the following experiment was set up at the Michigan State College Muck Experimental farm which has muck classified as Carlisle and is well drained by tile lines spaced 60 feet apart. An 0-10-20 fertilizer containing 5-percent copper sulfate is used in this work. The treatments are replicated six times and the plots are eight rows wide (11 feet) and 53 feet long. The following treatments are included in the experiment: 1) 400 pounds applied with the grain drill; 2) 400 pounds, 1 inch below the seed; 3) 600 pounds in a band, 1 inch below the seed; 4) 800 pounds in a band, 1 inch below the seed; 5) 800 pounds in a band, 2 inches below the seed; 6) 800 pounds in a band, 3 inches below the seed; 7) 800 pounds, 1 inch to the side of and 2 inches below the seed; 8) 800 pounds, with the grain drill; 9) 800 pounds with the grain drill plus 800 pounds, 3 inches below the seed; 10) 400 pounds with the grain drill plus 400 pounds, 1 inch below the seed; and 11) 400 pounds, 1 inch below the seed, and 400 pounds applied as a side-dressing approximately 6 weeks after planting.

The fertilizer band is approximately 1 inch wide, and all distances are measured from the inside edge of the fertilizer band; e.g., a band placed 1 inch to the side of and 2 inches below the seed means that the inner edge of the fertilizer band is 1 inch to the side of the seed and the top of the band 2 inches below the seed level.

This experiment is so laid out that the same treatment appears on the same area each year. This arrangement is made so as to insure that the residual effect of the previous application of fertilizer, if any, is confined to the corresponding plot. The copper sulfate is mixed with the fertilizer because this muck soil is very responsive to copper applications.

Downing's Yellow Globe seed has been used at the rate of 4 pounds of seed per acre. The seed is mixed with Arasan at the time of planting for smut control. As soon as the onions emerge, they are dusted at weekly intervals, with a 5-percent Chlordane dust as a means of controlling onion maggot. This method of control has proven very

satisfactory and apparently gives a 95-percent control of this particular insect. As was mentioned before, it was necessary to discard the onion fertilizer placement data for 1947 and 1948 because of onion maggot. The onion seed was planted on May 3, 1949, and on May 1, 1950. The respective dates of harvest for the two years were September 2 and September 9.

The data obtained for the two years are presented in Table 1. These data point out a very marked effect of the placement of fertilizer on the yield of onions in both 1949 and 1950. Applying the fertilizer with the grain drill was not as efficient as applying the fertilizer in bands below the seed. The data also point out the seasonal difference in the effect of fertilizer placement. In 1950, higher yields of onions were obtained than in 1949 when the fertilizer was applied in bands. Lower yields of onions were obtained in 1950 than in 1949, when the fertilizer was applied with the grain drill. These data show that the highest average yield for any of the treatments over the 2-year period was from an application of 800 pounds, applied with the grain drill, plus 800 pounds applied 3 inches below the seed, at planting time. Apparently, 800 pounds of fertilizer was not sufficient to produce maximum yields of onions.

It was mentioned before that one of the purposes of this experiment was to attempt to eliminate the effect of residual fertilizer from the effect of placement. Increasing the rate of fertilizer from 400 to 800 pounds per acre gave a higher percentage increase in 1950 than it did in 1949. Likewise, 1,600 pounds of fertilizer gave greater increases in yield in 1950 than in 1949. This indicates that part of this residual effect of fertilizer on the yield has been accounted for. From these data, the treatment in which the fertilizer was placed in a band 1 inch to the side of and 2 inches below the seed was approximately the same as if the fertilizer were applied in a band 2 inches below the seed. If this trend continues, it would seem unnecessary to construct a machine that would place the fertilizer directly under the seed. A machine that would place the fertilizer an inch to the side and 2 inches below would be equally satisfactory. This particular side placement is also satisfactory for a number of row crops grown on mineral soils; thus, a drill adaptable to both mineral and muck soils might effect a considerable saving to the growers through the economy of increased volume of machine sales.

Applying the fertilizer at the time of planting has been just as efficient, or in fact, more so, than applying split applications—that is, half of the fertilizer applied at the time of planting and the other half applied as a side-dressing. Likewise, applying all the fertilizer in a band below the seed has given higher yields than splitting the application by applying one-half of the fertilizer with a grain drill and one-half one inch below the seed.

The data in Table 1 do not tell the entire story because low yields are due in part to the smaller size of onions, thus, materially decreasing the sale value of the onions (Fig. 2).

TABLE 1—*Effect of fertilizer placement on the yield of onions, Michigan State College Muck Experimental Farm*

Treatment* No.	Pounds 0-10-20	Placement	Stand† 80 feet of row	50-pound bags per acre		
				1949	1950	Average
1	400	Grain drill	572	298	158	228
2	400	Band 1″ below seed	604	402	377	390
3	600	Band 1″ below seed	610	421	493	457
4	800	Band 1″ below seed	636	456	528	492
5	800	Band 2″ below seed	579	467	554	511
6	800	Band 3″ below seed	635	492	488	490
7	800	Band 1″ to side of, 2″ below seed	696	473	543	508
8	800	Grain drill	586	335	322	329
9	800	Grain drill				
	800	3″ below seed	657	496	606	551
10	400	Grain drill				
	400	1″ below seed	615	425	427	426
11	400	Side-dress				
	400	1″ below seed	581	420	464	442
		L.S.D.	65	43	94	

Variety: Downing's Yellow Globe.
*5 percent copper sulfate mixed with the fertilizer.
†1949 data.

In view of the fact that a marked response to nitrogen was obtained in 1950, it is planned to change the fertilizer analysis in 1951 to a 3-9-18 instead of the 0-10-20.

For the past two seasons there has been no apparent effect on germination with any of the treatments used. However, in view of previous experiences, and because the treatment in which the fertilizer was placed in a band 2 inches below the seed gave the highest yields when comparative amounts of fertilizer were applied, it is suggested that this depth would be the logical one to use. Thus, the fertilizer would be close enough to the seed to give maximum yields and at the same time would not be too close to interfere with germination.

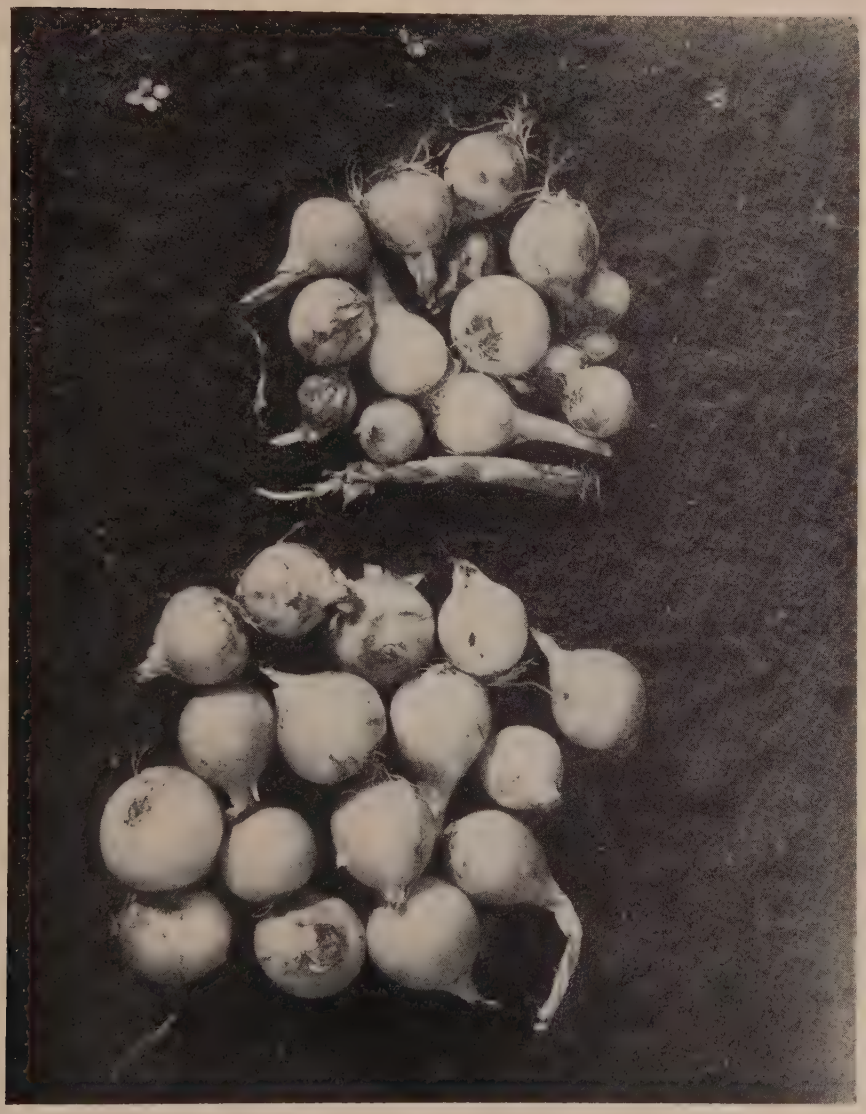

Fig. 2. Large onions from plot receiving 800 pounds of 0-10-20 fertilizer, 2 inches below the seed. Small onions from plot on which 800 pounds of fertilizer was applied with a grain drill. Michigan State College Muck Experimental Farm, 1950.

Occasionally, it has been shown that fertilizer placed 3 inches below the seed has resulted in lower yields, probably because of being too great a distance between the seed and fertilizer and, thus, acting more slowly in stimulation of early growth. Conversely, fertilizer placed in a band 1 inch below the seed will sometimes cause stand injury,

especially with dry soil conditions, thus, placing further emphasis on the need for the "2 inch below" placement.

SUMMARY

Data for 1949 and 1950 obtained from a replicated experiment on the effect of fertilizer placement of onions are reported.

The object of this experiment, which is continuing, is to study the effect of fertilizer placement on the yield and quality of onions and to eliminate the possible residual effect of previous fertilizer application from the effect of placement.

Based on these data and on other observed results, it is recommended that fertilizers for the onion crop be placed in a band 2 inches below the seed level either 1 inch to the side or directly under the seed, provided the rate of application does not exceed 1,000 pounds per acre. Quantities in excess of 1,000 pounds per acre should be applied with a grain drill. This recommendation does not imply that a subsequent application of nitrogen or some micronutrient element as a side-dressing under certain conditions may not be required.

Localized fertilizer placement actually improved the quality of the onions in that low yields were accompanied with small onions, an important market consideration.

A TRANSPLANTER FERTILIZER-PLACEMENT ATTACHMENT DESIGNED FOR ORGANIC SOIL INVESTIGATIONS

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CELERY is one of the important crops grown on organic soils. Large quantities of fertilizer are used in the production of this crop, with rates in excess of one ton per acre annually. At the present time the fertilizer is usually applied either broadcast or with a grain drill. A very marked response to fertilizer placement has been found in experiments with other crops produced on muck soil. As much as 70 percent increase in the yield of onions has been observed when the fertilizer was placed in a band 2 inches below the seed, as compared with applying the same quantity of fertilizer with a grain drill which placed the fertilizer in bands 7 inches apart and 3½ inches below the surface of the soil. In order to investigate the efficiency of fertilizer applied by the localized band method on celery, it was necessary to construct a special fertilizer placement attachment to fit a conventional type of transplanter.[2]

The special fertilizer placement equipment is mounted on a two row self-propelled, self-guiding celery transplanter, an over-all view of which is presented in Fig. 1. The fertilizer attachment consists of two units, each equipped with adjustable fertilizer placement shovels and an endless belt fertilizer dispenser driven by an independent ground wheel. The front wheel of the transplanter was replaced with one of larger size with a standard 16-inch automobile tire in order to support the added weight. Also, additional lugs and extension rims were mounted on the drive wheels of the transplanter mainly to provide additional traction to overcome the extra draft resulting from the fertilizer placement equipment. Details of the equipment are shown in Figs. 2, 3, and 4.

[1]Departments of Soil Science and Agricultural Engineering, Michigan Agricultural Experiment Station; and Bureau of Plant Industry, Soils and Agricultural Engineering, U.S. Department of Agriculture, Beltsville, Md. This project is part of the cooperative program between the above-named agencies which was inaugurated in 1947.

[2]Acknowledgment is made to the Holland Transplanter Company for parts supplied in the construction of this machine.

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The endless-belt type of fertilizer hopper (Figs. 1, 2, 3, and 4) is of the same design as the U.S.D.A. hopper developed under the Fertilizer Distributing Machinery Project at Beltsville, Maryland. A center partition devides the hopper into two compartments (Fig. 4) for independently controlling the fertilizer placed in a band at each side of the row. When only one band is needed, the fertilizer is deposited in only one of the compartments.

The endless belt is operated by a heavy metal drive wheel (1, Fig. 2) which is raised or lowered by lever 5, Fig. 2. The rates of fertilizer application are changed primarily by depositing different amounts of fertilizer on all or part of the 30-inch horizontal section of the belt. The relative rate of travel of the belt can be changed by mounting sprockets of different sizes at point 2, Fig. 2. After the proper sizes of drive sprockets are selected to move the belt the desired distance as the machine travels over a plot of a particular length, further changes of sprockets are not necessary unless a plot of different length is used or some radical change in soil conditions significantly effects the rotation of the drive wheel.

The machine has operated satisfactorily within the limits of our experiments. In changing the rates of fertilizer application, cans con-

Fig. 1. Overall view of transplanter with fertilizer placement equipment.

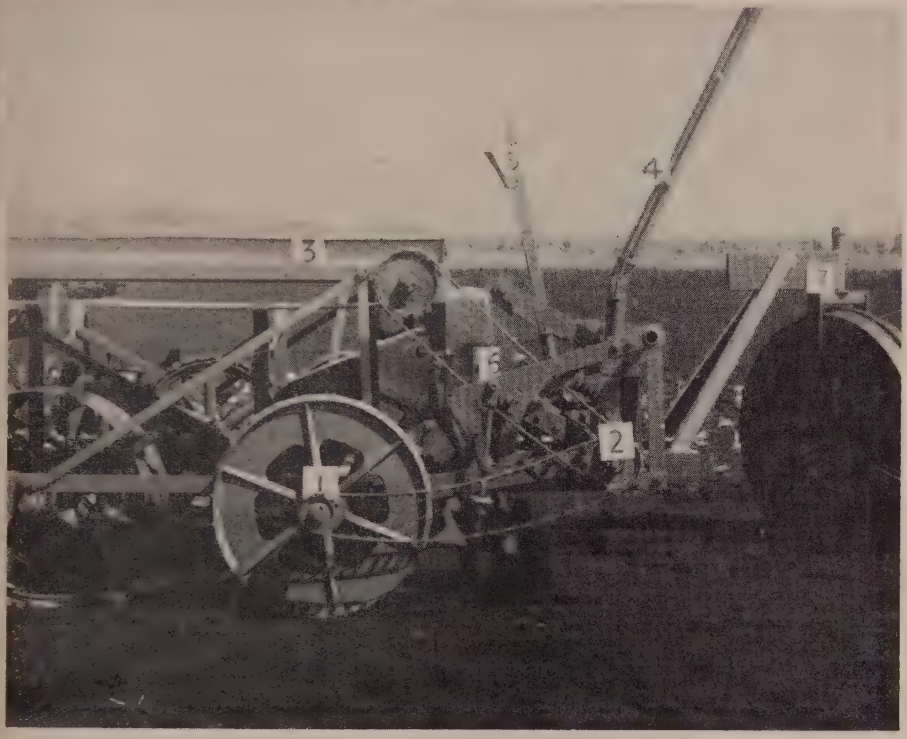

Fig. 2. 1—Drive wheel for fertilizer hopper. 2—Rate-change sprocket assembly. 3—Belt-type fertilizer hopper.. 4—Lever for fertilizer shovel depth adjustment. 5—Lever controlling fertilizer-hopper drive wheel. 6—Parallelogram fertilizer furrow-opener assembly. 7—Front wheel assembly.

taining a weighed amount of fertilizer are used. For example, if 750 pounds of fertilizer an acre is the rate for a particular treatment, the amount of fertilizer needed is weighed into a container that is cut down to this exact size. The fertilizer is then spread on the 30-inch horizontal section of the belt. (In the celery experiments, the plots were 30 feet long.) When selected sizes of sprockets in the driving system are used, the belt travels forward one inch for each foot of travel of the machine. The belt hopper is suitable for the type of experiment conducted and it provides a precise way of applying fertilizer. Furthermore, little attention, if any, is required to clean out the hopper between plots.

The fertilizer placement shovels are mounted on a parallelogram assembly, thus, they remain in a vertical position as they are raised and lowered. The assembly is attached to a square bar (6, Fig. 3)

which is actuated by lever 5, Figs. 1, 2, and 3. The notches on the lever quadrant are spaced so that the position of the shovels or depth of fertilizer placement is changed one inch when the lever is moved from one notch to the next.

The fertilizer furrow openers are spear-point type of shovels modified for use in muck soil. Two fertilizer bands can be placed in different positions with respect to each row. The machine can be adjusted so that the fertilizer can be placed only 3 inches apart. The fertilizer can be satisfactorily placed as deep as 6 inches below the surface of the muck when it is deposited in only one band and as deep as 3 inches when it is deposited in two bands.

Three experiments were run during the 1950 season, with six different placements and four rates of application. The placements were: 1) broadcast, 2) one-half the fertilizer broadcast and one-half side-dressed 5 weeks later, 3) one band directly below the row and 6 inches

Fig. 3. 1—Fertilizer shovels. 2—Rate-change sprocket assembly. 3—Belt-type fertilizer hopper. 4—Lever for fertilizer shovel depth adjustment. 5—Lever controlling fertilizer-hopper drive-wheel. 6—Parallelogram for fertilizer furrow-opener vertical adjustment. 7—Front wheel assembly.

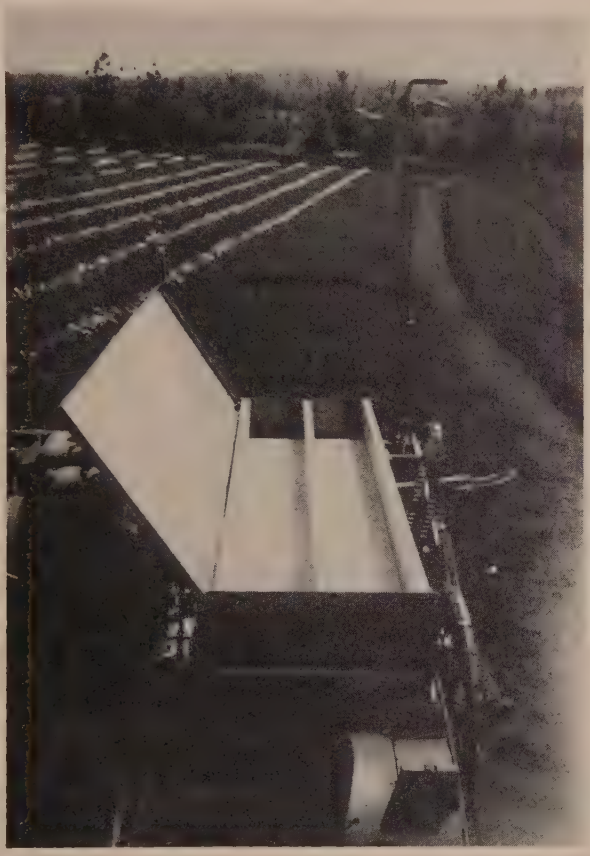

Fig. 4. Interior of endless belt two-compartment fertilizer hopper.

below the surface of the ground, 4) one band 2½ inches to the side of the row and 5 inches below the surface of the ground, 5) two bands 2½ inches to the side of each row and 5 inches below the surface of the ground, and 6) a so-called "high-low" treatment, in which one band was 3 inches below the surface of the ground and the other band 5 inches below the surface with 5 inches between the inner edges of the two bands.

Since the transplanter is satisfactory for transplanting a number of different crops, it will be possible in the future, as time permits, to study the effects of fertilizer placement on a number of different crops grown on muck soils.

FURTHER TESTING OF HERBICIDES IN STRAWBERRY PLANTINGS

By R. F. CARLSON and J. E. MOULTON

DEPARTMENT OF HORTICULTURE

In the past 6 years 2,4-D has been used experimentally, and to some extent commercially, to control broad-leaved weeds in strawberry plantings (1, 2, 8). Isopropyl N-phenylcarbamate is another selective herbicide which has been used on strawberries. It is especially useful when chickweed is a problem (3, 4). In preliminary tests commercial preparations known as Experimental Herbicides (EH) 1, 2 and 5722 have given selective control of weeds for certain crops (5, 6, 7). The purpose of the tests reported here was to compare the effectiveness of some of these newer materials as herbicides in strawberry plantings.

MATERIALS AND METHODS

One acre of Hillsdale sandy loam was planted May 20 with the Premier variety of strawberry. The rows were spaced 3 feet apart, and randomized 50-foot row sections, replicated four times, were laid out for each treatment. The planting was cultivated at regular intervals conforming to the standard practice of strawberry culture.

Five materials were used as follows: 2,4-D at ½ and 2 pounds per acre; IPC (isopropyl N-phenylcarbamate) at 5, 10 and 15 pounds; EH 1 (sodium 2,4-dichlorophenyl "cellosolve" sulfate) at 2, 3 and 4 pounds; EH 2 (dichloral urea) at 3, 6 and 9 pounds; and EH 5722 (formula not available) at 1, 2 and 3 pounds per acre. Two applications were made—the first one on June 4, 15 days after planting, and the second July 18, 6 weeks later. Some weeds had emerged at the time of the first application. At the 1, 2 and 3-pound rates, EH 5722 had little effect on the weeds and none on the strawberry plants. Therefore, the rates for the second application were raised to 2, 4 and 6 pounds per acre respectively. All materials were applied in a 2-foot band over the row with a knapsack sprayer at the rate of 50 gallons

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per acre. The rate per acre was based on the area sprayed which constituted about one-half the actual field acreage.

Weed control was measured by counting the weeds per square foot, four counts being taken per treatment, on two different dates, June 28 and August 15. After each count, the weeds remaining in all treatments were removed by hoeing and the time required to hoe out the weeds was recorded for each treatment. On September 27 the effect of the various chemicals on runner production was determined by counting the runners on five plants in each treatment and obtaining an average for each replication. The tolerance of the strawberry plants to the chemicals was measured by the number of runners produced during the season. Since this was a first-year planting all blossoms were removed by hand and, consequently, no yield records were obtained.

The weeds in the area included many that commonly create a problem in strawberry growing, such as rough pigweed (*Amaranthus retroflexus L.*), common ragweed (*Ambrosia elatior L.*), and downy-bromegrass (*Bromus tectorum L.*), Common chickweed (*Stellaria media L.*), however, was not present.

RESULTS

EFFECTS OF 2,4-D

The first application of ½ pound of 2,4-D controlled 55 percent of the weeds and the second application at the same rate, 6 weeks later, controlled 80 percent. The first application of 2 pounds of 2,4-D gave 95-percent control, and the second application at the same rate, 6 weeks later, controlled 84 percent of the weeds (Table 1). One-half pound of 2,4-D apparently was not enough. Some of the weeds had emerged at the time of the first application and these were killed at the low concentration, but at the higher rate both the seeds that were germinating in the soil as well as the emerged seedlings were destroyed. Both rates retarded the growth of the strawberry plants, and some reduction in stand was observed at the 2-pound rate. The number of runners was reduced 46 percent at the ½-pound rate and by 91 percent at the 2-pound rate. Aside from runner reduction the plants appeared normal at the end of the first growing season.

EFFECTS OF EH 1

EH 1 at 2, 3 and 4 pounds per acre gave 64, 72 and 84 percent control of weeds, respectively. Control with EH 1 at 4 pounds per

acre was equal to that with 2 pounds of 2,4-D and superior to all other materials used in these tests (Table 1). No curvature or formative effects were observed and the plants appeared normal at all concentrations throughout the growing season. The runner production in all treatments with EH 1 was equal to that in the check plots (Fig. 1).

EFFECTS OF IPC

Because some of the weeds had already emerged when IPC was applied it did not control the weeds satisfactorily. For maximum control this material should be applied just at or prior to germination of most weed seed (4). The only apparent injury to the strawberry plants was a reduction in runners as compared to the check plots (Table 1).

EFFECTS OF EH 2

From early observations it appeared that EH 2 had very little effect on either weeds or strawberry plants, however, the final records reveal that some weeds were killed and that runner production was greatly reduced, especially at the high concentration of nine pounds per acre

Fig. 1. Effect of EH 1 on weed control and runner production, showing no reduction in plant growth. Left row received two applications of 4 pounds each on June 4 and July 18. Right row untreated.

Fig. 2. Effects of EH 1 and EH 2 on weed control and runner production. Left row received two applications of 2 pounds each of EH 1 on June 4 and July 18. Right row received two applications of 3 pounds each of EH 2 on the same dates.

(Fig. 2). Downy-brome-grass was controlled in these tests, whereas, the broad-leaved weeds were not affected so much at these concentrations.

EFFECTS OF EH 5722

Under the conditions of these tests, EH 5722 did not give satisfactory control of weeds. When the concentrations were doubled (from 1, 2 and 3 to 2, 4 and 6 pounds per acre, respectively) for the second application the foliage of the strawberry plants was "burned" resulting in a reduction in their growth as well as a reduction of runners. The plants appeared normal by the end of the season. Both EH 2 and EH 5722 apparently are substances very effective in preventing runner production and might have practical application where the hill system of growing plants is practiced or with varieties which commonly produce too many runners.

EFFECT OF MATERIALS IN REDUCING LABOR

Accurate records were taken of the time spent in eliminating weeds by hand weeding and hoeing in all treated and check plots. Where 2

pounds of 2,4-D was used, the time spent in eliminating the remaining weeds was 9.9 hours compared with 63.3 hours for the check. EH 1 at 4 pounds per acre reduced the hand labor from 63.3 hours to 18.8 hours per acre. The 2 and 3-pound rates of EH 1 required 30 and 20 man-hours respectively and were also satisfactory in this respect. The other materials used, although reducing labor to some extent, were not so effective (Table 1).

TABLE 1—*Effect of several herbicides on strawberry runner production, destruction of weeds, and man-hours of hoeing per acre*

Materials	Pounds per acre*	Percent runners	Percent weed control		Man-hours of hoeing per acre		
			1st Count	2nd Count	1st Hoeing	2nd Hoeing	Total
2, 4-D	½	54	55	80	18.9	5.0	23.9
2, 4-D	2	9	95	84	8.3	1.6	9.9
EH 1	2	94	52	64	23.9	6.1	30.0
EH 1	3	109	66	72	16.1	4.4	20.5
EH 1	4	94	83	84	14.4	4.4	18.8
EH 2	3	45	2	4	35.8	11.6	47.4
EH 2	6	18	8	52	33.3	6.6	39.9
EH 2	9	4	32	52	30.0	5.3	35.3
IPC	5	67	10	8	36.0	13.3	49.9
IPC	10	54	19	20	31.1	10.0	41.1
IPC	15	31	24	36	30.0	8.3	38.3
EH 5722	1	41	33	6	36.4	12.3	48.7
EH 5722	2	23	36	10	34.2	11.6	45.8
EH 5722	3	4	42	24	30.6	7.2	37.8
Control	0	100	..	..	43.3	20.0	63.3

*Pounds per acre applied on June 4 and July 18 based on the area sprayed (row-application)

DISCUSSION AND SUMMARY

In the spring of 1950, five herbicides, at three concentrations each, were used in a newly set planting of the Premier variety of strawberry. A second application of the same materials was made 6 weeks after the first. Weed counts and hoeing time were recorded twice during the season. Runner counts were made September 27. Since no fruit was harvested the first season, no yield data were recorded.

Satisfactory weed control was obtained with one application of 2,4-D at the rate of 2 pounds per acre, whereas, the ½ pound rate controlled 55 percent of the weeds. Retardation of plants was observed, and because the second application came at a critical period when runners were being initiated, runner production was greatly reduced with 2 pounds of 2,4-D. This reduction in runners has not been ob-

served when one application of the herbicide was made early in either the first-year bed or in the second-year bed (1, 2). Apparently two applications of 2,4-D as close together as 6 weeks, or at the time (July 18) when runners are being initiated may result in the production of fewer runner plants. Or the reduction in runners perhaps was due to the persistence of 2,4-D within the plant from both applications as reported for woody plants (9). Timing the application so that the material will not interfere with the initiation of runners and flower buds is important, especially when hormone-like materials are used.

The new material EH 1 gave 58, 69 and 84 percent weed control (based on the check) at 2, 3 and 4 pounds per acre respectively. The strawberry plants appeared at least as vigorous as the checks during the first growing season. No significant reduction in runners was recorded at any level of EH 1. Completed tests indicate that EH 1 at 3 or 4 pounds per acre can be used safely twice during the growing season. Where the weed population is such that larger dosages of EH 1 are required, the rate can be increased to 6 pounds per acre without injury to strawberry plants (5). According to prior work, EH 1 is most effective on germinating seeds, and perhaps better control of weeds in these tests would have been obtained if the material had been applied approximately 5 days after setting the strawberry plants rather than 15 days later.

Under the conditions of these tests the materials IPC, EH 2 and EH 5722 did not show as much promise in weed control in strawberries as did EH 1 and 2,4-D (Table 1). Some burning of the foliage was observed from the second application of EH 5722. All materials used, except EH 1, reduced runner production.

Hand labor was reduced by two-thirds or more where EH 1 and 2,4-D were used, and by about one-third with the other materials.

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FURTHER DEVELOPMENTS IN WEED CONTROL IN GLADIOLUS

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IN 1947 Krone and Hamner (3) reported on the use of 2,4-D and various contact herbicides for the control of weeds in plantings of gladioli. Their aim, in part, was to eliminate or destroy most of the weed seeds in the upper soil horizon, and the range of concentrations used by them was rather high—from 2½ pounds per acre to more than five times this amount. They obtained satisfactory control of weeds without apparent injury to the gladioli by planting the corms 3 weeks after the application of 2,4-D. Since that report, 2,4-D has been used in various ways on a considerable acreage by a number of commercial growers.

From the practical standpoint it is more desirable to apply the materials following planting rather than before. In the tests reported here, the materials were applied after the corms were planted but before either the weeds or gladiolus leaves emerged. It has been found that germinating seeds are much more easily killed than the growing seedlings and consequently lower concentrations of the herbicide will give satisfactory results (1). The primary aim in this work was to test several new commercial compounds, at minimum herbicidal rates, in an effort to obtain maximum control of weeds with the least effect on the production of corms and flowers.

MATERIALS AND METHODS

A little less than one acre of land was planted to gladiolus corms and cormels in 1950. The soil varied from a heavy dark organic loam to a sandy clay loam. Approximately one-half of this area was planted with size 6 corms and the other half with cormels, both of the Gardenia variety, set in rows 4 feet apart. Each treatment consisted of a strip of row 50 feet long and 2 feet wide. Each treatment was replicated four times.

[1]Grateful acknowledgement is made to Earl Weaver and Son, Bronson, Michigan, for supplying the gladiolus corms and cormels used in this work.

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The materials used on the corms and rates per acre were as follows: 2,4-D at 1 and 2 pounds; Experimental Herbicide 1 (EH1) (sodium 2,4-dichlorophenyl "cellusolve" sulfate) at 2, 3 and 4 pounds; EH 2 (dichloral urea) at 3, 6, and 9 pounds; "Premerge" (alkanolamine salt of dinitro-o-sec-butylphenol) at 3.0, 4.5 and 6.0 pounds; and "TAT G-W" (2,4-D, 2.54 percent and phenyl mercuric acetate 7.50 percent at ½, ¾, and 1 pound based on the 2,4-D acid equivalent of the commercial preparation. This amounts to about 2.4, 3.6 and 4.7 gallons of "TAT G-W" per acre respectively. On the cormals the above and also the following materials were used: IPC (isopropyl N-phenyl carbamate) at 5, 10 and 15 pounds; EH 5722 (formula not available) at 1, 2 and 3 pounds; and Aero Cyanate (potassium cyanate 91 percent at 12.5, 25.0 and 37.5 pounds. All materials were applied in aqueous solution with a knapsack sprayer at the rate of 50 gallons per acre. The rate per acre was based on the area sprayed which constituted about one-half the actual field acreage of corms.

The corms and cormels were planted June 15 and the herbicides applied June 21. Weed counts of all treatments were taken July 12. This was done by determining the number of weeds in a square foot in four areas per treatment. The weeds were removed by hand pulling and hoeing from all plots on August 7. The time required for this operation was computed as man-hours per acre. The corms were dug October 4 and the yields recorded in pounds per acre and percentage of check for each treatment (Table 1).

Many weeds were present in the check plots, some of the most common being rough pigweed (*Amaranthus retroflexus L.*), purslane (*Portulaca oleracea L.*), lamb's quarters (*Chenopodium album L.*), common ragweed (*Ambrosia elatior L.*), crabgrass (*Digitaria sanguinalis* (*L.*) *Scop.*) and downy-bromegrass (*Bromus tectorum L.*).

RESULTS

WEED CONTROL IN AREA PLANTED WITH CORMS

At the rates in this experiment, 2,4-D, EH 1 and "TAT G-W" gave the most uniform and consistent control of weeds. All these materials gave 60 percent or more control, depending on the concentration of the herbicide used (Table 1). "TAT G-W" also controlled the annual grasses (crabgrass and downy-bromegrass) present in this planting. EH 1 compared favorably with 2,4-D in effectiveness as an herbicide.

When used at 1 and 2 pounds per acre, 2,4-D gave 68 and 83 per-

TABLE 1—*Effect of several herbicides on destruction of weeds, man-hours of hoeing per acre and yield in gladiolus*

Materials	Pounds per acre	Corms			Cormels		
		Percent		Man-hours hoeing	Percent		Man-hours hoeing
		Weed control	Yield		Weed control	Yield	
2,4-D	1.0	68	97	11.0	53	100	10.0
2,4-D	2.0	83	93	7.2	82	88	8.3
EH 1	2.0	67	88	15.8	74	51	11.7
EH 1	3.0	70	90	15.0	80	69	7.5
EH 1	4.0	89	71	8.3	92	69	4.2
EH 2	3.0	17	98	26.7	47	56	23.3
EH 2	6.0	40	99	14.1	62	100	15.0
EH 2	9.0	52	94	13.3	65	48	13.3
"Premerge"	3.0 *	44	90	25.0	59	66	15.0
"Premerge"	4.5 *	52	87	24.0	65	98	12.5
"Premerge"	6.0 *	62	91	18.3	82	100	10.8
"TAT G-W"	0.5 †	59	100	19.1	68	100	12.5
"TAT G-W"	0.75†	67	100	17.5	88	100	9.2
"TAT G-W"	1.00†	82	100	10.8	92	100	6.7
IPC	5.0	..	...	....	39	85	20.8
IPC	10.0	..	...	....	41	95	20.0
IPC	15.0	..	...	....	65	80	15.8
EH 5722	1.0	..	...	....	0	100	49.2
EH 5722	2.0	..	...	....	0	77	40.0
EH 5722	3.0	..	...	....	12	100	37.5
"Aero Cyanate"	12.5	..	...	....	0	95	40.0
"Aero Cyanate"	25.0	..	...	....	0	100	44.2
"Aero Cyanate"	37.5	..	...	....	0	100	46.7
Check	0.0	..	100	35.8	...	100	45.8

*"Premerge" contains 3 pounds of DNOSBP per gallon.
†Expressed in terms of 2,4-D acid equivalent in the commercial preparation.
This amounts to about 2.4, 3.6 and 4.7 gallons of "TAT G-W" per acre, respectively.

cent control of weeds, respectively. Since the material was applied 6 days after the corms were planted, many of the weed seeds were germinating and some were emerging, thus providing favorable conditions for maximum kill with 2,4-D. EH 1, applied at the rate of 2, 3 and 4 pounds per acre, gave 67, 70 and 89 percent weed control respectively. The timing of the application is very important with EH 1 since this material acts primarily on germinating seed (2). "TAT G-W" was used at the rate of ½, ¾ and 1 pound per acre, based on the 2,4-D content in the formulation, and the control of weeds was 59, 67 and 82 percent, respectively. The material "Premerge" satisfactorily controlled the weeds at the 6-pound rate; however, 3.0 and 4.5 pounds per acre evidently were not sufficient to control the weeds under these conditions. The control was 44, 52 and 62 percent at 3.0, 4.5 and 6.0 pounds per acre, respectively. Since all the materials were calculated on the basis of the area sprayed (row treatment), the rates used are actually low, amounting to 1.5, 2.3 and 3.0 pounds per acre when the total acreage of the field is considered.

WEED CONTROL IN THE PLANTINGS OF CORMELS

"TAT G-W" at ½, ¾ and 1 pound per acre, applied 6 days after planting, controlled 68, 88 and 92 percent of the weeds, respectively (Fig. 2). Most of the grasses present were controlled at those rates, and yields of corms were not reduced.

The material EH 1, used at 2, 3 and 4 pounds per acre, gave comparable control of the weeds, but there was some reduction in the yield of corms without, however, visible injury to the foliage (Fig. 1).

Two pounds per acre of 2,4-D gave control of weeds in the planting of cormels similar to that reported above for corms. The 1-pound rate controlled 53 percent of the weeds (Table 1 and Fig. 2) "Premerge" used at 3.0, 4.5 and 6.0 pounds per acre eliminated 59, 65 and 82 percent of the weeds, respectively (Fig. 1).

The materials EH 2 and IPC at the rates used were not so effective in controlling the weeds as were the other herbicides. EH 2 gave 47, 62 and 65 percent control at 3, 6 and 9 pounds per acre, respectively, and IPC at 5, 10 and 15 pounds controlled 39, 41 and 65 percent of the weeds. Since "Aero Cyanate" is a contact herbicide, the weeds were not controlled at any rate by this material.

Fig. 1. Weed control in gladiolus from cormels: (Left background) 6 pounds of "premerge" per acre and (right) 4 pounds of EH 1. Untreated plots in the foreground.

Fig. 2. Weed control in gladiolus cormels with 2 pounds 2,4-D (left) and ¾ pounds "TAT G-W" (right). In the background are untreated and other treated areas.

The time spent in hoeing was reduced greatly by some treatments. Only 8.3 and 4.2 man-hours per acre were required on areas where 2 pounds of 2,4-D and 4 pounds of EH 1, respectively, had been applied. In contrast, 45.8 man-hours per acre were required to hoe untreated areas. Other treatments reduced labor anywhere from ¼ to ¾ of that required to eliminate the weeds in untreated areas (Table 1).

DISCUSSION

Four of the herbicides used in these tests satisfactorily controlled the weeds in gladiolus plantings. Eighty percent or more of the weeds were eliminated during the season on the plots where the following materials were used at the rates indicated: 1 pound of "TAT G-W", 4 pounds of EH 1, 2 pounds of 2,4-D, and 6 pounds of "Premerge". It is believed that by increasing the rate of "Premerge" to 8 pounds control would be still better and yet practical since that amount would cover two acres of gladiolus by the row spraying system in actual field practice. No appreciable reduction in the yield of corms resulted from any of the treatments. Since yields from small planting stock consisting of corms and cormels is often variable, any small difference due to treatment is difficult to detect.

EH 2 and EH 5722 were not satisfactory in these tests. IPC perhaps might be more effective if used under different conditions. Aero Cyanate used as a contact spray on small weeds is very effective but shows little promise for use as a pre-emergence herbicide.

Previous work indicates that a second application of EH 1, "TAT G-W" or 2,4-D, in the early stages of growth before the leaves start to spread, will not harm the gladiolus if the rates are kept low. EH 1 at 3 pounds, "TAT G-W" at ¾ pounds and 2,4-D at 1 pound per acre are suggested for this purpose.

EH 1, "TAT G-W", 2,4-D and "Premerge" reduced by three-fourths or more the man-hours per acre required to keep the planting free of weeds. This represents a substantial saving for the gladiolus grower because the cost of hand weeding often amounts to $75-$100 per acre.

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SETTLING OF POLES USED FOR FARM BUILDINGS

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MANY FARMERS are in need of some economical method of building adequate farm buildings or are looking for some inexpensive materials that can be used in the construction of their buildings. The high costs of conventional building materials have forced many farmers to operate without adequate buildings.

Because of this high cost of building materials there has been a revival of the practice of using poles as the supporting members in the building.

Pole-type construction as now used consists of pressure-treated creosote poles set from 3 to 5 feet deep and 12 to 15 feet on center in each direction, the poles being long enough to reach to the roof. A framework of dimension lumber is secured to these poles to which are nailed the roof boards or the siding. Common practice is to use galvanized iron for the roof and vertical boards for the siding, which work out very well and can be applied by the farmer.

REASONS FOR THE STUDY

From experiences with this type of construction in previous years, two causes for failure were evident to the authors. The bottoms of the poles rotted off, thus causing the building to settle out of shape, and the lack of sufficient bearing under the poles to carry the weight caused uneven settling.

By pressure-treating the poles with creosote, it is possible to extend the life of the poles and consequently the building, to 30 or 40 years which is considered a lifetime by most farmers. Then too, during that length of time farming methods and conditions may change, thereby making some buildings obsolete and unserviceable.

Settling of poles is still a problem, and very little is known about the amount of settling that will take place over a period of time. This project was started in an attempt to find out the amount of settling

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Fig. 1. Types of structures made with pole-type construction.

and/or heaving that will take place when poles are set in the ground, under various conditions.

REVIEW OF LITERATURE

A preliminary review of literature indicated that there was very little information available. Considerable work has been done on the use of piling for the support of foundations, but in this case "skin

friction" is the important factor which supports most of the weight. Then too, piling is driven into more or less restricted soil, while the poles used for farm construction are many times set in loose unrestricted soil. When set in this manner, 3 to 5 feet deep, most of the weight would be carried as compression on the pole ends. This, then, is the important factor in farm building design: to make the poles large enough to keep the weight on the soil within safe limits.

Most authorities on the subject of soil-bearing power give figures ranging from 30 to 70 pounds per square inch as being the safe bearing capacity on continuous footings of the shallow or surface type. This might or might not apply to pole end-bearing capacity as the pole ends are isolated single foundations. In some soils in which the ground water table is close to the bottom of the poles it is not uncommon to use 20 pounds per square inch as the safe bearing capacity of the soil (1).

Krynine (2) points out another significant factor that a large pole with a given load per square inch will settle more than a small pole with the same load per square inch. If this is true, then the results obtained might be magnified when larger poles are used.

When these poles are used for electric lines it is not uncommon for them to settle. However the power company engineers indicate that the line tension seems to take care of this factor so that trouble is seldom encountered from this source.

Fig. 2. Group D on clay immediately after loading.

Fig. 3. Group D on clay one year after loading.

Schaffhausen (3) reported that the average well-drained farm soil should support 27 pounds per square inch.

RESULTS OF THE FIRST YEAR'S OBSERVATIONS

In June 1949 a series of five posts, each 3 inches x 3 inches with loads of 1 psi (pounds per square inch), 30 psi, 50 psi, 70 psi, and 82 psi were set in four different types of soil—sand, clay, gravel, and silt. The posts were set 2 feet in the ground and in a vertical position as shown in Fig. 2. The elevations were taken on a 20d nail driven in the top of the posts. After one year the following results were recorded:

Clay Soil		Gravel Soil		Sandy Soil		Silt	
Weight, psi	Change in elevation, ft.	Weight, psi	Change in elevation, ft.	Weight, psi	Change in elevation, ft.	Weight, psi	Change in elevation, ft.
1	−.02	1	+.01	1	−.01	1	.00
30	−.31	30	−.03	30	−.09	30	−.05
50	−.62*	50	−.15	50	−.06	50	−.22
70	−.64*	70	−.18	70	−.15	70	−.49
82	−.57*	83	−.56*	82	−.04	82	−.61

*Bottom of weight-box resting on the ground.

These preliminary data indicate that regardless of the type of soil in which the posts were set there was some settling. The amount of settling appeared to be proportional to the load per square inch applied to the top of the post. The sandy soils which were well-drained supported the various weights with less settling than any of the other types. The clay soil allowed the most settling.

The four groups of posts were located within an area of one square mile. The land is gently rolling so that the posts set in sand were on high, well-drained sites. The posts set in silt and clay were located in the lower places which were not as well-drained; however, water did not stand in these areas. Additional tests will be necessary to determine the effect of moisture in the soil, on settling.

The results indicate that for the types of soils tested a load of 30 pounds per square inch is the maximum amount that can be supported safely on poles used in farm buildings. This means that there should be one square inch of bearing for each one square foot of roof area. For example, a 10 x 10 inch square post will support 100 square feet of roof area, or a 16-inch round pole (202 square inches cross-section) will support 202 square feet of roof area. In accordance with this suggestion, 16-inch poles should be set not farther than 14 inches apart. Smaller poles should be placed closer together. Whenever additional loads, such as straw or hay, are supported on the poles, additional concrete footings should be used. One square inch of bearing area should be added to the pole for each 30 pounds of weight.

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MICHIGAN STATE GREEN-GOLD: A NEW CELERY RESISTANT TO FUSARIUM YELLOWS

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FUSARIUM YELLOWS is a destructive, systemic, soil-borne disease of celery which became serious in the intensive districts of Michigan from 1912 to 1919 (2). It seriously threatened to destroy the industry in those districts before effective control was accomplished. The causal fungus, *Fusarium apii,* can persist indefinitely in the soil in the absence of celery, subsisting on muck and organic detritus and subsequently becoming reactivated as a parasite when contact is re-established with the roots of susceptible varieties of celery. The disease has not been successfully controlled by any practical method except the development of resistant varieties.

By 1918 the growing of the yellow or self-blanching varieties of celery had practically been abandoned in the infested soils of Kalamazoo County because of the ravages of Fusarium yellows. Growers who had repeated crop failures with the dwarf strain of Golden Self-Blanching, then planted naturally resistant varieties of green celery. The variety Newark Market was generally grown for a number of years. It was never popular with the growers or shippers because it was difficult to blanch in boards and the markets then preferred well-blanched stalks of yellow celery. It, like many other varieties, developed a bitter flavor during the high temperatures of summer. Nevertheless, Newark Market was a valuable variety during this period when it was questionable whether the celery industry could survive the devastation wrought by Fusarium yellows. By its use the industry was maintained while the initial breeding work was proceeding to develop resistance in yellow celery.

The first resistant selections from the dwarf strain of Golden Self-Blanching were made in 1919. From these selections there was developed at Michigan State College the first variety of yellow celery bred especially for resistance to Fusarium yellows. Seed was first available to growers in 1926. Meanwhile the tall strain of Golden Self-Blanch-

Contribution 51-2 of the Department of Botany and Plant Pathology, Michigan State College.

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ing was developed by Vilmorin in France and it immediately became popular in Michigan. At first it appeared to have more resistance to Fusarium yellows and it was much more resistant to leaf blights than the dwarf strain. Although it developed much yellows in the summer crop, the growers soon learned they could grow it for the early market, since it matured before the high temperatures of summer stimulated rapid development of root disease. Varieties like Early Fortune, Wonderful and others in the so-called Golden Plume group, also appeared during this period. Of these, Early Fortune has been widely grown for an early crop because it is much more resistant to Fusarium yellows than the tall strain of Golden Self-Blanching and some other varieties in the Golden Plume class.

A resistant selection was made in 1930 from a planting of one of the susceptible varieties of Golden Plume in Kalamazoo. Only five plants survived in a one-acre planting and of these only one proved resistant to Fusarium yellows. From this resistant plant Michigan Golden was developed(1). This variety has been extensively grown in the infested soils of Michigan and other states and is still a standard variety in many of these infested areas. Other resistant varieties were developed by commercial seedsmen and by Cornell University. Cornell 19, developed by crossing a green and a yellow variety, is one of the best of the yellow varieties because it inherits some of the better qualities of the green parent. It is not suitable for the earliest plantings because of a marked susceptibility to bolting.

As a group the green celeries are more resistant to Fusarium yellows than the yellow and, in addition, they have better quality. Edibility of celery is determined by several factors, important among which is fiber content. The yellow varieties usually contain more fiber and, consequently, are more stringy than the green kinds. The highest quality green celeries have comparatively thick, inconspicuously ribbed stalks. The low fiber content of these varieties results in very frangible stalks which are easily crushed in field handling at harvest, in storage and in transit. Consequently, these green celeries are difficult to harvest and market without serious impairment in appearance and salability. These disadvantages have restricted the growing of the best quality varieties for shipment to distant markets.

Green varieties of celery are now grown in many celery-producing areas of the United States. Quality in celery is determined not only by variety but also by soil and climatic conditions. Maximum quality

is developed where the days are sunny but temperatures are moderate in daylight and cool at night. The plant also has a high water requirement. These favorable conditions are best met in the irrigated, high altitude and coastal regions of the western mountain states and of the Pacific Coast. High summer temperatures in Michigan, often accompanied by deficient rainfall, are detrimental to the attainment of highest quality in any variety.

Since the yellow varieties are too stringy, especially for the summer crop, and the best green varieties are too brittle for normal handling, the need for Michigan growers is a variety that is less stringy than the best of the yellow celeries and less brittle than the superior types of green celery. Such a variety would probably stimulate increased demand since it could be marketed without excessive crushing in the normal processes of harvesting and marketing.

Because of the preferred edibility of the green varieties and the gradual education of the consumer to the use of unblanched celery, it seems probable that the demand for green celery will increase and correspondingly diminish for the yellow. In some states, notably Colorado, Utah and those on the Pacific coast, green celery is grown for shipment to eastern markets. This celery, produced under ideal climatic conditions, is of superior quality and has helped to stimulate a demand for green celery. In some markets this demand exceeds that for yellow celery. It is not anticipated that celery of comparable quality can be grown in Michigan, for summer marketing.

MATERIALS AND METHODS

In the development of Fusarium yellows resistance, it seemed feasible to combine some of the superior quality of the best green celeries with the high disease resistance of Michigan Golden. At the time this work was initiated, the Downing strain of Fordhook was an outstanding green variety for quality. This strain was developed by Mr. C. E. Downing of Sunfield, Michigan, by repeated selection from the original strain of Fordhook. His celery was stored in trenches and marketed at Christmas and later. It was renowned in local markets for very superior quality. The plants were comparatively short and very stocky, with smooth, thick stalks which blanched in the ventilated trenches to an attractive creamy white color. It was sold by weight at premium prices. As a source of Fusarium yellows resistance several

selections of Michigan Golden were used, including plants which grew taller than those of the normal strain.

Initial crosses, made in 1933, were between these selected plants of Michigan Golden and the Downing strain of Fordhook. The parent plants were inclosed in breeding cages and cross-pollinated by blow flies. Seeds were harvested only from Michigan Golden since green color is dominant in the F_1 generation. Segregations occurred for dark green, medium green, light green and yellow plants in the F_1 populations. All the green plants were varietal hybrids. Selected plants were self-pollinated and the progenies grown on Fusarium-infested soil. The most resistant and desirable plants were selected for seed production. A number of lines were similiarly grown for several generations and repeatedly reselected to establish color, disease resistance and other desired qualities.

RESULTS

One of the strains isolated in 1941 under the accession number 654 was subsequently mass selected through three additional generations. A commercial seed crop was grown in 1949 and samples distrib-

Fig. 1. Michigan State Green-Gold (left) and Cornell 19 at harvest time, 1950. Note taller and more vigorous growth of Michigan State Green-Gold. The plants were the same age when set in the field.

Fig. 2. Michigan State Green-Gold packed in the Howard crate. 36-plant pack. Average weight of the trimmed plants, 2 pounds. Grown at Muskegon, Michigan, 1950.

uted to interested growers in most of the celery-growing sections of the state. Reports from these growers, inspection of their plantings, together with the results of experimental plantings in Kalamazoo County, show this to be a desirable commercial variety of light green celery.

This hybrid is highly resistant to Fusarium yellows and is recommended for growing in intensive celery-growing areas where Fusarium yellows is established, like those of Kalamazoo County. It is not resistant to leaf blights, though it has been less injured than many other varieties, because it is more erect growing and consequently forms narrower rows (Fig. 1) which facilitate circulation of air and rapid drying after rains or heavy dews.

This variety was especially bred for Michigan climatic conditions, growing to maturity in 90-100 days under average summer conditions or 100-110 days in autumn. The plants are medium to large, taller than many green types observed, averaging 8-10 inches to the first joint, with solid stalks moderately ribbed and free from excessive

stringiness and suckering. Well-grown plants average 2-3 pounds net weight and are especially well adapted to marketing in the Howard crate commonly used in Michigan (Fig. 2). Preliminary cold storage tests in 1950 indicate good storing qualities.

This new hybrid celery was tested under the original accession number and is known to some Michigan growers as Michigan State 654. It is now named "Michigan State Green-Gold" and will be marketed under that name. Seed may be obtained from Grand Rapids Growers, Inc., distributors of Michigan Golden seed.

SUMMARY

Fusarium yellows, a destructive, soil-borne disease of celery, has not been successfully controlled by any practical method except the development of resistant varieties.

A resistant strain of dwarf Golden Self-Blanching was developed at Michigan State College from 1919 to 1926 by selection from the commercial strain of the same variety. Michigan Golden was developed by similar methods from 1930 to 1933 from a susceptible variety in the Golden Plume group.

Present market trends are toward increasing consumption of green celery. The best varieties are difficult to handle because of excessive brittleness and consequent damage in harvesting and marketing. The present need is for resistant varieties developed especially for growing in Michigan and which are reasonably resistant to damage in handling.

Using the Downing strain of Fordhook and a tall selection of Michigan Golden as parents, a light-green, hybrid celery has been developed that is highly resistant to Fusarium yellows, is of good quality and is suitable for growing in Michigan either as a summer- or autumn-maturing variety.

This new hybrid celery is named "Michigan State Green-Gold" and seed is available for commercial use in 1951.

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JOURNAL ARTICLE ABSTRACTS

The Binding of Blood Serum Gamma Globulin by Sulfadiazine

HUDDLESTON, I. F., SANDERS, E. AND MATTANO, L. A.

Am. Jour. Vet. Res. 11(41):366-370. 1950 (Journal Article 918 from the Michigan Agricultural Experiment Station)

It has been shown that the addition of phosphoric acid (H_3PO_4) to a mixture of sodium sulfadiazine and bovine serum produces a precipitate which consists of serum protein and sulfadiazine. The physical character of the protein removed by the drug was determined by electrophoretic analysis. Most of the protein removed had the characteristics of *gamma* globulin.

The protein fraction separated from Brucella antiserum by means of sulfadiazine precipitation has been shown to have antibody properties of a high order. The antibody in the presence of serum complement will inhibit the growth of Brucella organisms. These two agents in the presence of a low concentration of sodium sulfadiazine form a bactericidal complex.

Use of Thorium Nitrate as a Radioactive Standard for Immersion-Type Geiger-Mueller Tubes

SHIRLEY, RAY L.

Analytical Chem. 22:732. 1950 (Journal Article 1016 from the Michigan Agricultural Experiment Station)

Immersion-type Geiger-Mueller tubes are used for measuring radioactivity in solutions. Bale and Bonner reported that a solution of 100 grams of potassium acetate per 100 ml. of water was a satisfactory standard for determining reproductibility of counts with tubes of this type. The writer has found that thorium nitrate compared with potassium salts has advantages as a radioactive standard for immersion-type tubes, in that much greater beta-particle radioactivity may be obtained per volume of solution. Five ml. of a 0.02 N thorium nitrate solution has the equivalent activity of the same volume of 5 N potassium acetate. Five ml. of a 2.4 N solution of thorium nitrate had an activity of approximately 7000 counts per minute when assayed for radioactivity with the dipping-type tubes used in this laboratory.

Since thorium nitrate is a common laboratory reagent, has a long half-life and a high radioactivity, and is very soluble in water, it appears to be a valuable radioactive standard for checking the reproducibility of counts of immersion-type Geiger-Mueller tubes and corresponding counter circuits.

Studies on Canine Leptospirosis. I. Evaluation of Laboratory Diagnostic Procedures. II. Serological Determination of the Evidence of Latent Infection in the Lansing, Michigan Area

NEWMAN, J. P.

Am. Jour. Vet. Res. 11(41):405-411. 1950 (Journal Article 1044 from the Michigan Agricultural Experiment Station)

Staining, cultural, and serological procedures were conducted on the blood and urine collected from 30 naturally-infected dogs to determine the value of these procedures for the laboratory diagnosis of canine leptospirosis.

The staining and cultural procedures are not considered reliable diagnostic methods. The agglutination test was approximately 50 percent accurate after the second week of illness and 100 percent accurate after the third to fourth week.

The sera from 500 normal dogs were examined by the agglutination test in retrospective diagnosis. Of the 29.6 percent of the dogs demonstrating some titer to either *L. canicola* or *L. icterohaemorrhagiae* antigens, or both, 26.2 percent were positive with *L. canicola,* 2.6 percent were positive with *L. icterohaemorrhagiae,* 0.8 percent showed an equal titer with both antigens.

Male and female incidence of latent infection was approximately 2:1.

The incidence of the infection, as evidenced by the results of Experiment II, increased with the age of the dogs.

The results of Experiment II indicate that nearly one-third of the dogs in the Lansing area, are possible reservoirs of *Leptospira* infection, from which other dogs and man may acquire leptospirosis.

The Optimum Incubation Temperatures for the Primary Isolation of Coliform Organisms

BONIECE, JOANNA R., AND MALLMANN, W. L.

Jour. Am. Water Works Assoc. 42:155-160. 1950 (Journal Article 1079 from the Michigan Agricultural Experiment Station)

The customary incubation temperature for the bacteriological analysis of water samples has been 37°C. The incubation temperature for the bacteriological analysis of milk is now done at 35°C. This study was made to determine whether 35°C. would be suitable for water analysis work. These studies demonstrated that optimum growth temperature for *Esch. coli* and *Aer. aerogenes* is in the sewage of 35-37°C. The normal optimum growth temperature for *Intermediate I.* is approximately 35°C. Incubation at 32°C. for primary isolation is also superior to 37°C., although a longer incubation period is necessary than at either 35° or 37°C.

Application of Soil Tests, Tissue Tests, and Foliar Analysis to Field Experiments

LYND, J. Q., TURK, L. M., AND COOK, R. L.

Soil Sci. Soc. Am. Proc. 14:236-241. 1950 (Journal Article 1080 from the Michigan Agricultural Experiment Station)

A partial chemical analysis was made on soils taken from rotation-fertilizer field experiments at the beginning and after seven years of continuous treatment.

Plant tissue tests and foliar analyses were made on the corn plants of these field experiments during the growing seasons of 1947 and 1948.

Soil analysis of samples taken from the fertilizer-rotation field experiments at the beginning and after seven years of continuous experimental treatment did not show differences sufficiently great to account for the differences in corn yields.

Tissue tests throughout two growing seasons on these fertilizer-rotation field experiments indicated that nitrogen is the limiting factor in plant growth and that a definite change took place in the nitrogen status of plants with the initiation of the flowering period.

Foliar analysis for total nitrogen in leaf samples taken during the flowering period indicated positive correlation with corn yields. The interpretation of foliar analysis data in terms of tissue test results is proposed.

Drainage Ditchbank Stabilization for Organic Soils

DAVIS, J.F., AND HARRISON, C. M.

Proc. Soil Sci. Soc. Amer. 14:283-286. 1949 (Journal Article 1086 from the Michigan Agricultural Experiment Station)

Sixteen grasses and legumes were planted on a ditch bank at the Michigan State College Muck Experimental Farm as a possible means of stabilizing the ditch. A well established grass cover practically prevented filling the ditch through wind action. Approximately 25 percent of the ditch capacity was filled with muck on areas unprotected by grass.

The following criteria are presented for an ideal grass for spoil bank plantings on organic soils: winter hardiness, low growing, root system capable of holding soil from eroding, growth maintained to the water's edge but not persisting under wet conditions, and maintenance of a green succulent growth to reduce the danger of fire hazard resulting from accumulated mature herbage.

Of the species investigated, redtop, rough-stalked meadow grass and Chewings fescue have shown the most promise to date in most nearly fulfilling the above-mentioned requirements.

Anatomical Modification of Velvet Bent Grass (Agrostis Canina L.) Caused by Soil Treatment with 2,4-Dichlorophenoxyacetic Acid

WATSON, D. P.

Am. Jour. Botany 37(6):421-431. 1950 (Journal Article 1093 from the Michigan Agricultural Experiment Station)

Twenty-eight-day-old seedlings of *Agrostis canina L.* var. Velvet Bent were treated with 2,4-D in water. This treatment caused reduction in root system, an appearance of nodule-like growths on the roots, and formation of a swollen area at the base of the plant. Microscopic examination of leaves revealed that the newly formed leaves in the bud contained much replacement tissue similar to that found in dicotyledonous buds and that there was a relation between the age of the leaf at the time of treatment and the severity of injury. The swollen base contained many root initials, the development of which had been stimulated by the chemical. Root initials increased in number along the primary root, but their elongation was inhibited, reducing the overall size of the root system of the treated plants.

Five-Year Performance of Several Apple Varieties on Malling Rootstocks in Michigan

TUKEY, H. B. AND CARLSON, R. F.

Proc. Am. Soc. Hort. Sci. 54:137-143. 1949 (Journal Article 1103 from the Michigan Agricultural Experiment Station)

Eighteen stock-scion combinations of apple trees on Malling rootstocks, involving 180 trees, responded favorably to growing conditions in Michigan on a relatively light soil and during two drouthy seasons. They grew vigorously and developed and fruited in about the same relationships as observed in other locations in eastern United States. In size, the largest trees were those on Malling XII, followed in descending order by Malling XIII, then by a group comprising Malling V, IV, I, and II, with trees on Malling VII the smallest. In blossoming and fruiting precocity was in reverse order, with the earliest-bearing on the Malling VII rootstock, followed by Malling I and II, which in turn were followed by Malling IV, V, and XIII, with Malling XII the most tardy. Malling XIII appeared a precocious rootstock for Golden Delicious but relatively less so for Cortland. Malling VII produced both small and early-bearing trees which are more substantial than trees on Malling IX. Cropping is associated with the bearing habits of the variety, in which McIntosh bears heavily on strong spur development and Cortland less heavily on terminals.

Nutrient-element Composition of Leaves from Normal Fruit Trees

KENWORTHY, A. L.

Proc. Amer. Soc. Hort. Sci. 55:41-46. 1950 (Journal Article 1111 from the Michigan Agricultural Experiment Station)

Leaf samples were collected from 100 blocks of fruit of 6 varieties. The trees used did not show any visible symptoms of excess or deficiency. The samples were analyzed for nitrogen, phosphorus, potassium, calcium, magnesium, manganese, iron, boron and copper. The data showed characteristic variations between varieties as well as kinds of fruit. Apple leaves contained less N, Ca, and Mn than peach leaves. Cherry leaves contained more N, Ca, Mg, Cu, and B than apple leaves. Pear leaves contained more Ca, Mn, and Cu but less P, Fe and B than apple leaves. Peach leaves contained more N, P, Mg, Fe and B but less Mn and Cu than pear leaves. Cherry leaves contained more N, P, Mg, Fe and B but less Mn than pear leaves. The various nutrient-elements showed considerable variation within normal leaves. Mn, Fe, Cu and B had a greater variation between samples than P, Ca, and Mg with N having the least variation. Many of the leaves showed levels of nutrient-elements commonly considered as being deficient.

Nutrition and Dietary Habits of Aging Women

OHLSON, MARGARET A., JACKSON, LOIS, BOEK, JEAN, CEDERQUIST, DENA C., BREWER, WILMA D., AND BROWN, EDNA G.

Am. Jour. Public Health 40(9):1101-1108. 1950 (Journal Article 1113 from the Michigan Agricultural Experiment Station)

Studies of the food intake and nutrition of older women of the Lansing area have been made.

No one technique of evaluating food consumption gave an entirely complete and reliable pattern of the characteristic intake of the individual. The 24-hour recall diet record, though less quantitative than a weighed diet, also imposed the least restriction on activity and resulted in apparently higher intakes of food. Diets computed by the short method of Donelson and Leichsenring (1945) accurately reflected the results of laboratory analyses to nitrogen, calcium, and phosphorus except in cases of limited food intakes or where predominance of bread, processed meats or intricate cookery mixtures were found.

The dietary patterns of this area are such that the total calories ingested per 24 hours may be taken as an index of the adequacy of the supply of specific nutrients of that diet if the food selected is reasonably varied and some milk is included daily. A minimum of 1,600 to 1,800 calories per day was required for equilibrium of protein, calcium, and phosphorus in balance studies on 14 women under 70 years. Since three out of four women over 70 were able to maintain body reserves on approximately 1,500 calories, it is possible that total food needs may be lower after 70. It would appear that the reduction occurs rather abruptly in response to a decreasing number of activities and interests.

Outside interests and activities as well as freedom from tension and strain are factors which must be evaluated in the instruction and feeding of aging women if nutritional adequacy is to be expected.

Aging women are individuals. The art, as well as the science, of nutrition is necessary to understand their nutritional needs.

Leuconostoc mesenteroides as the Cause of Ropiness in Canned Peaches

FABIAN, F.W., AND HENDERSON, R. H.

Food Research 15(5):415-419. 1950 (Journal Article 1153 from the Michigan Agricultural Experiment Station)

Leuconostoc mesenteroides was isolated from the syrup of canned peaches which had become ropy. The article also contains a table giving a list of foods in which ropiness has occurred and the causative organism together with the literature reference.

A Technique for Whole Mount Autoradiographs of Rabbit Mammary Glands

LUNDAHL, L.F., MEITES, JOSEPH, AND WOLTERINK, L. F.

Science 112 (2916):599-600. 1950 (Journal Article 1159 from the Michigan Agricultural Experiment Station)

Growth of male rabbit mammary glands was induced by injecting estrone and progesterone daily for periods of 25 or 35 days. Four hours before sacrifice the rabbits were each given a single intravenous injection of 50 uc of radioactive phosphorus (P^{32}). The glands were removed, dried, and exposed to x-ray film for 72 hours. The extent of mammary proliferation and the areas of most active growth could be clearly differentiated by this method.

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